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AUTHOR	Matson, James; Stokes, Tad
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ABSTRACT

This document contains 20 competency-based examinations with student and instructor manuals for electronics and instrumentation occupations. For each of the examinations, the student manual contains the following: the competency, the performance objective, directions, the materials and equipment needed, a space to note time started and time finished, and the competency examination, which consists of tasks to perform. The instructor's manual includes the same materials as the student manual, with specific instructions to the examiner and a competency examination rating sheet. The 20 examinations cover the following material: (1) constructing a direct current series circuit; (2) constructing a direct current parallel series circuit; (3) constructing a series-parallel resistive circuit and measuring voltage drops, current, resistance, and computer power; (4) and constructing and analyzing a direct current series resistive capacitive circuit; (5) determining alternating current time-frequency voltage measurement; (6) identification of opens in overcurrent protection; (7) troubleshooting and repairing fluorescent lighting; (8) troubleshooting high pressure sodium lighting fixtures; (9) installing and testing a transformer circuit; (10) using AC test equipment to locate opens and shorts in a motor controller; (11) testing semiconductor diodes and bipolar junction transistor, to identify defects; (12) troubleshooting cascaded C/E (Common Emitter) amplifiers; (13) troubleshooting cascaded C/E amplifiers using the signal tracing method; (14) calibration and operation of a temperature bridge; (15) calibration and operational check of an instrumentation summing amplifier; (16) performing alignment of an A.M. superhetrocyne receiver; (17) receiver troubleshooting; (18) verification of correct operation of a seven-segment display driven by a decoder driver and a decade counter; (19) performing minimum performance check of an eight trace logic analyzer; and (20) verifying proper operation of a frequency counter. (KC)

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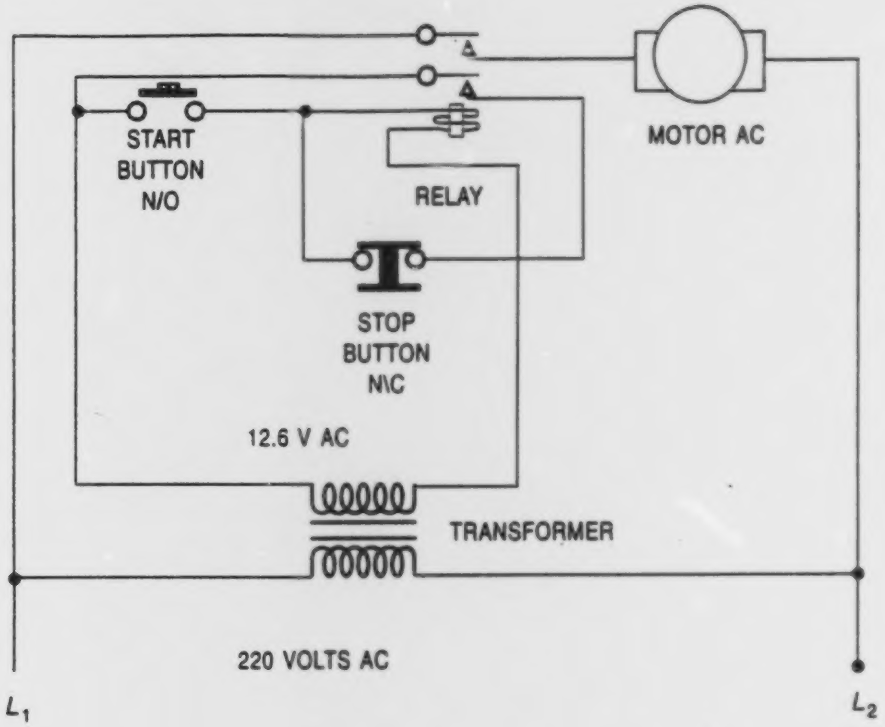
COMPETENCY EXAMS

STUDENT AND INSTRUCTOR MANUALS


START
BUTTON
N/O
RELAY
MOTOR AC
STOP
BUTTON
N\C
12.6 V AC
TRANSFORMER
220 VOLTS AC
L_1
L_2

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

JUNE, 1993

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Competency Exams
for
Electronics / Instrumentation Occupations

Prepared by

Mr. James Matson, Instructor
Victoria Independent School District
and
Mr. Tad Stokes, Instructor
Victoria College

Edited by

David Ingram, Project Director

For

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Project Staff:
Vicki Oglesby, Project Administrator
David Ingram, Principal Investigator
Bill E. Lovelace, Project Researcher

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Mr. John Denison, Instructor
Drafting Technology
Paris Junior College
Paris, Texas

Ms. Georgia Hankins, Director
Permain Basin Quality Workforce Planning Commission
Midland, Texas

Dr. Jerry King, Dean
Vocational/Technical Education
Trinity Valley Community College
Athens, Texas

Ms. Brenda Lovett, Manager
Workforce Development Division
Texas Department of Commerce
Austin, Texas

Dr. Douglas Pickle, Division Chairman
Industrial Technology
Amarillo College
Amarillo, Texas

Mr. Al Pollard, Dean
Technical Education
McLennan Community College
Waco, Texas

Ms. Linda Rife, Executive Director
Texas Council of Vocational Education
Austin, Texas

Dr. Barry Russell, Director
Central Texas Tech-Prep Consortium
Temple Junior College
Temple, Texas

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Dr. Harley Davis
Liaison of Business and Industry
Paris Junior College
Paris, Texas

Mr. John Denison
Drafting Technology Instructor
Paris Junior College
Paris, Texas

Dr. Vanessa Evans Huse
Computer Science Instructor
Kilgore College
Kilgore, Texas

Mr. Bill Kammerer
Food Production Instructor
Central Texas College
Killeen, Texas

Ms. Maribeth King
Chairperson of Computer Science
Kilgore College
Kilgore, Texas

Mr. James Matson
Tech Prep Electronics Instructor
Victoria I.S.D.
Victoria, Texas

Ms. Julie Southworth
Food Production Teacher
Temple High School
Temple, Texas

Mr. Tad Stokes
Electronics/Instrumentation Instructor
Victoria College
Victoria, Texas

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STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CONSTRUCT A DIRECT CURRENT SERIES CIRCUIT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #1

Competency: Construct a Direct Current Series Circuit.

Performance Objective: Given the proper tools and equipment the student will demonstrate the ability to construct a direct current series circuit to current industry standards, achieving 100% mastery on the performance exam.

1) This exam consists of nine tasks.

2) You will be rated on your ability to perform each of the tasks to current I.S.A. standards.

3) The maximum time allowed for this exam is 1 hour.

4) When instructed by the examiner, return the work station to its pre-exam condition.

5) The student exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials\Equipment Needed:

Schematic Diagram
Assorted Resistors
Job Sheet
Scientific Calculator
Pencil
Digital Multi-Meter
Breadboard
Variable Power Supply
Jumper Wire

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

TO CONSTRUCT A DIRECT CURRENT SERIES CIRCUIT

PERFORMANCE EXAM:

TASK 1 USE SCHEMATIC TO SELECT RESISTORS FOR A DIRECT CURRENT SERIES CIRCUIT

1) Refer to figure 1 and select R1, R2, and R3 from assorted resistors.

TASK 2 UTILIZE RESISTOR COLOR CODE VALUES TO DETERMINE VALUE FOR RESISTANCE, CURRENT AND VOLTAGE

1) Using color code values and Ohms Law, calculate the value for:
   a) Total resistance = ________________
   b) Total current = ________________
   c) Voltage drop for resistor 1 = ______________
   d) Voltage drop for resistor 2 = ______________
   e) Voltage drop for resistor 3 = ______________

TASK 3 USE A DIGITAL MULTI-METER FOR MEASURING RESISTANCE

1) Using a digital multi-meter measure and record the actual values for:
   a) Resistor 1 = ____________
   b) Resistor 2 = ____________
   c) Resistor 3 = ____________

TASK 4 CONSTRUCT A CIRCUIT AND MEASURE RESISTANCE

1) Construct the circuit in Figure 1 and measure the total resistance:
   a) Total resistance = ____________

TASK 5 MEASURE VOLTAGE AND CURRENT

1) Apply power to the breadboard and adjust the power supply for 10 volts D.C.
2) Measure and record current values at:
   a) point a= ___________
   b) point b = ___________
   c) point c = ___________
   d) point d = ___________

TASK 6 MEASURE VOLTAGE DROPS

1) Energize the circuit and measure:
   a) Voltage drop across resistor 1 = __________
   b) Voltage drop across resistor 2 = __________
   c) Voltage drop across resistor 3 = __________

TASK 7 MEASURE CURRENT

1) Increase the total voltage to 15 volts and measure the new value of current:
   a) Total current at 15 volts = ____________
2) Decrease the total voltage to 5 volts and measure the new value of current:
   a) Total current at 5 volts = ____________

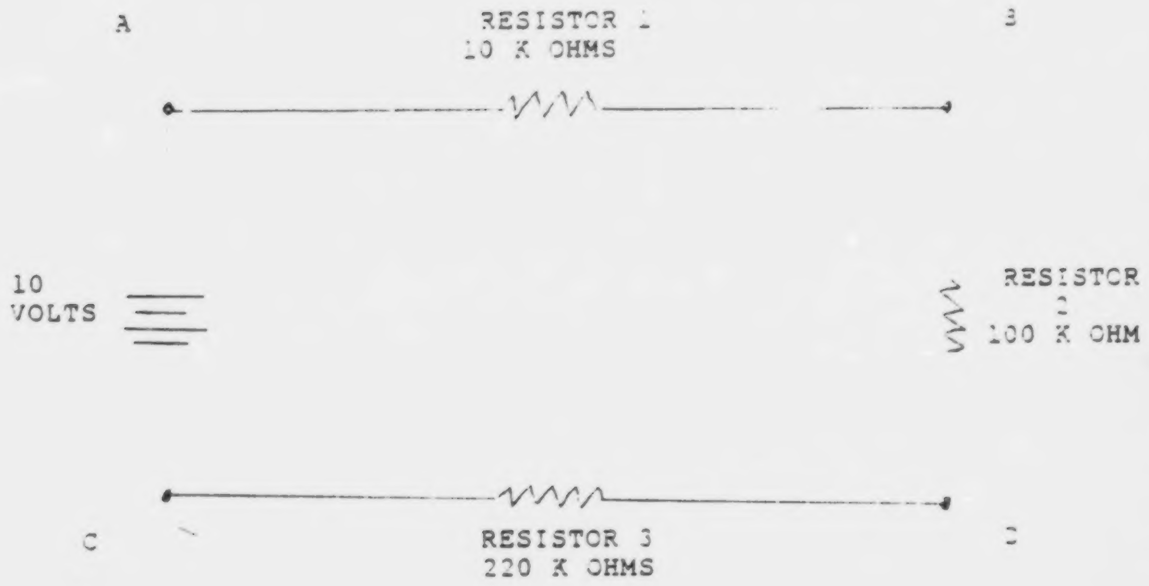
TASK 8 DIFFERENTIATE BETWEEN TWO CURRENT READINGS

1) Explain the difference between the two current readings obtained in TASK 7.

TASK 9 USE THE MEASURED VALUES OF VOLTAGE AND CURRENT TO DETERMINE POWER

1) Calculate power using the measured values of voltage and current for the circuit:
   a) Power across resistor 1 = __________
   b) Power across resistor 2 = __________
   c) Power across resistor 3 = __________
   d) Total power

FIGURE 1


A
RESISTOR 1
10 K OHMS
B
10
VOLTS
RESISTOR
2
100 K OHM
C
RESISTOR 3
220 K OHMS
D

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CONSTRUCT A DIRECT CURRENT SERIES CIRCUIT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #1

Competency: Construct a Direct Current Series Circuit.

Performance Objective: Given the proper tools, equipment and materials the student will demonstrate the ability to construct a direct circuit series to current industry standards, achieving 100% mastery on the performance exam.

1) Maximum time for exam is 1 hour.
2) There are nine tasks that the student must perform.
3) Documentation of ratings should be made on individual competency exam rating sheet.
4) Upon completion of the exam, verify that all testing materials and equipment are in your possession.

Material/Equipment Needed:

Schematic Diagram
Assorted Resistors
Job Sheet
Scientific Calculator
Pencil
Digital Multi-Meter
Breadboard
Variable Power Supply
Jumper Wire

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

TO CONSTRUCT A DIRECT CURRENT SERIES CIRCUIT

PERFORMANCE EXAM:

TASK 1 USE SCHEMATIC TO SELECT RESISTORS FOR A DIRECT CURRENT SERIES CIRCUIT

1) Refer to figure 1 and select R1, R2, and R3 from assorted resistors.

TASK 2 UTILIZE RESISTOR COLOR CODE VALUES TO DETERMINE VALUE FOR RESISTANCE, CURRENT AND VOLTAGE

1) Using color code values and Ohms Law, calculate the value for:
   a) Total resistance = ________________
   b) Total current = ________________
   c) Voltage drop for resistor 1 = ______________
   d) Voltage drop for resistor 2 = ______________
   e) Voltage drop for resistor 3 = ______________

TASK 3 USE A DIGITAL MULTI-METER FOR MEASURING RESISTANCE

1) Using a digital multi-meter measure and record the actual values for:
   a) Resistor 1 = ___________
   b) Resistor 2 = ___________
   c) Resistor 3 = ___________

TASK 4 CONSTRUCT A CIRCUIT AND MEASURE RESISTANCE

1) Construct the circuit in Figure 1 and measure the total resistance:
   a) Total resistance = ___________

TASK 5 MEASURE VOLTAGE AND CURRENT

1) Apply power to the breadboard and adjust the power supply for 10 volts D.C.
2) Measure and record current values at:
   a) point a= __________
   b) point b = __________
   c) point c = __________
   d) point d = __________

TASK 6 **MEASURE VOLTAGE DROPS**

1) Energize the circuit and measure:
   a) Voltage drop across resistor 1 = __________
   b) Voltage drop across resistor 2 = __________
   c) Voltage drop across resistor 3 = __________

TASK 7 **MEASURE CURRENT**

1) Increase the total voltage to 15 volts and measure the new value of current:
   a) Total current at 15 volts = ____________
2) Decrease the total voltage to 5 volts and measure the new value of current:
   a) Total current at 5 volts = ____________

TASK 8 **DIFFERENTIATE BETWEEN TWO CURRENT READINGS**

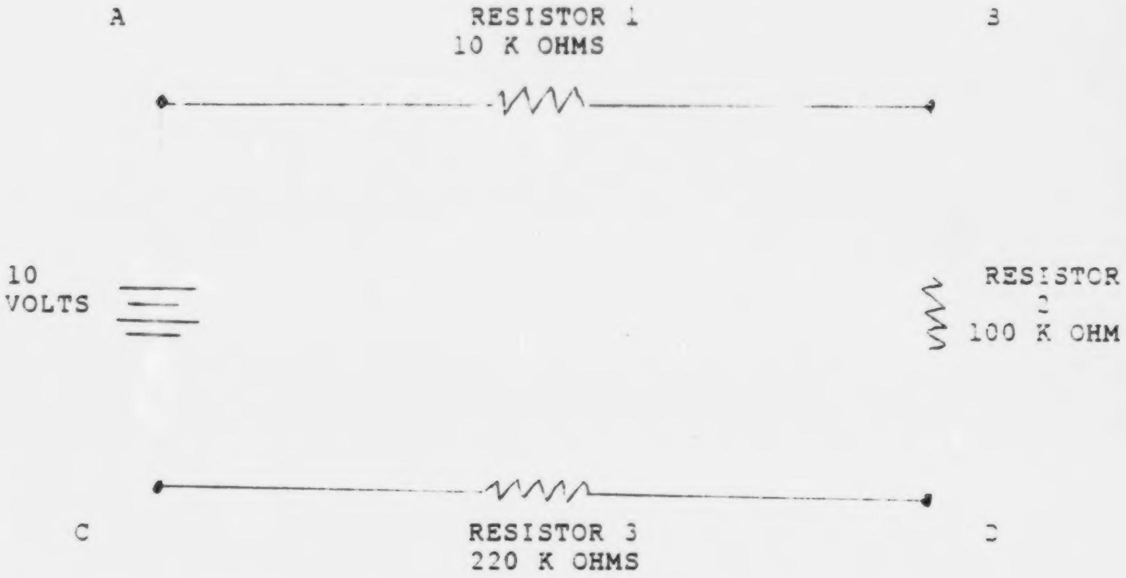
1) Explain the difference between the two current readings obtained in TASK 7.

TASK 9 **USE THE MEASURED VALUES OF VOLTAGE AND CURRENT TO DETERMINE POWER**

1) Calculate power using the measured values of voltage and current for the circuit:

a) Power across resistor 1 = __________
b) Power across resistor 2 = __________
c) Power across resistor 3 = __________
d) Total power

FIGURE 1


A
RESISTOR 1
10 K OHMS
B
10
VOLTS
RESISTOR
2
100 K OHM
C
RESISTOR 3
220 K OHMS
D

COMPETENCY EXAMINATION RATING SHEET

Competency: Construct a Direct Current Series Circuit.

Performance Objective: Given the proper tools and equipment the student will demonstrate the ability to construct a direct current series circuit to current industry standards, achieving 100% mastery on the performance exam.

STUDENT ______________________ Competency Mastered YES ____ NO ____

EXAMINER ______________________ Date of Rating ______________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Identified schematics and selected resistors.			
2. Utilized color code values to determine value for resistance, current and voltage.			
3. Used a digital multi-meter for measuring resistance.			
4. Constructed a circuit and measured resistance.			
5. Measured voltage and current.			
6. Measured voltage drops.			
7. Measured current.			
8. Differentiated between two current readings.			
9. Used the measured values of voltage and current to determine power.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CONSTRUCT A DIRECT CURRENT PARALLEL SERIES CIRCUIT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #2

Competency: Construct a Direct Current Parallel Series Circuit.

Performance Objective: Given the proper tools, equipment and materials, the student will demonstrate the ability to construct a direct current parallel circuit, to current industry standards, achieving 100% mastery on the performance exam.

1) This exam consists of nine tasks.

2) You will be rated on your ability to perform each of the tasks, to current I.S.A. standards.

3) The maximum time allowed for this exam is 1 hour.

4) When instructed by the examiner, return the work station to its pretest condition.

5) The student exam booklet, any scrap worksheets, and all equipment and materials must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials/Equipment Needed:

Schematic Diagram
Assorted Resistors
Job Sheet
Scientific Calculator
Pencil
Digital Multi-Meter
Breadboard
Variable Power Supply
Jumper Wire

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

TO CONSTRUCT A DIRECT CURRENT PARALLEL SERIES CIRCUIT

PERFORMANCE EXAM:

TASK 1 USE SCHEMATIC TO SELECT RESISTORS FOR A DIRECT CURRENT PARALLEL CIRCUIT

1) Refer to Figure 1 and select R1, R2, and R3 from assorted resistors.

TASK 2 USE RESISTOR COLOR CODE VALUES TO DETERMINE VALUE FOR RESISTANCE, CURRENT AND VOLTAGE

1) Using color code values and Ohms Law, calculate the value for:
   a) Total resistance = ________________
   b) Total current = ________________
   c) Voltage drop for resistor 1 = __________
   d) Voltage drop for resistor 2 = __________
   e) Voltage drop for resistor 3 = __________

TASK 3 USE A DIGITAL MULTI-METER FOR MEASURING RESISTANCE

1) Using a digital multi-meter measure and record the actual values for:
   a) Resistor 1 = ____________
   b) Resistor 2 = ____________
   c) Resistor 3 = ____________

TASK 4 CONSTRUCT A CIRCUIT AND MEASURE FOR TOTAL RESISTANCE

1) Construct the circuit in Figure 1 and measure the total resistance:
   a) Total resistance = ____________

TASK 5 USING THE BREADBOARD TO MEASURE THE POWER SUPPLY FOR VOLTS D.C.

1) Apply power to the breadboard and adjust the power supply for volts D.C.
2) Measure and record current values at:
   a) point a= ___________
   b) point b = ___________
   c) point c = ___________
   d) point d = ___________
   e) point e = ___________
3) Does IC + ID + IE = IA = IB? YES NO

TASK 6 MEASURE VOLTAGE DROPS

1) Measure and record the voltage drops across:
   a) resistor 1 = __________
   b) resistor 2 = __________
   c) resistor 3 = __________

TASK 7 MEASURE CURRENT

1) Increase the total voltage to 15 volts and record the value of current:
   a) Total current at 15 volts = ____________
2) Decrease the total voltage to 5 volts and record the value of current:
   a) Total current at 5 volts = _____________

TASK 8 DIFFERENTIATE BETWEEN TWO CURRENT READINGS

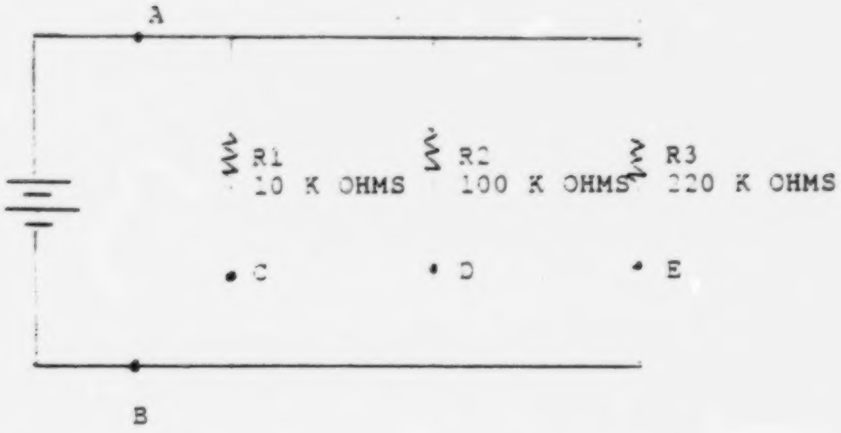
1) Explain the difference between the two current readings.

2) Does total resistance change?

TASK 9 USE THE MEASURED VALUES OF VOLTAGE AND CURRENT TO DETERMINE POWER

1) Calculate power using the measured values of voltage and current for the circuit:
   a) Power across resistor 1 = __________
   b) Power across resistor 2 = __________
   c) Power across resistor 3 = __________
   d) Total power

FIGURE 1


A
R1
10 K OHMS
R2
100 K OHMS
R3
220 K OHMS
C
D
E
B

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CONSTRUCT A DIRECT CURRENT PARALLEL SERIES CIRCUIT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #2

Competency: Construct a Direct Current Parallel Series Circuit.

Performance Objective: Given the proper tools, equipment and materials the student will demonstrate the ability to construct a direct current parallel series circuit to current industry standards, achieving 100% mastery on the performance exam.

1) The maximum time for exam is 1 hour.

2) There are nine tasks that the student must perform.

3) Documentation of ratings should be made on individual competency exam rating sheet.

4) Upon completion of the exam, verify that all testing materials are in your possession.

Materials/Equipment Needed:

Schematic Diagram
Assorted Resistors
Job Sheet
Scientific Calculator
Pencil
Digital Multi-Meter
Breadboard
Variable Power Supply
Jumper Wire

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

TO CONSTRUCT A DIRECT CURRENT PARALLEL SERIES CIRCUIT

PERFORMANCE EXAM:

TASK 1 USE SCHEMATIC TO SELECT RESISTORS FOR A DIRECT CURRENT PARALLEL CIRCUIT

1) Refer to Figure 1 and select R1, R2, and R3 from assorted resistors.

TASK 2 USE RESISTOR COLOR CODE VALUES TO DETERMINE VALUE FOR RESISTANCE, CURRENT AND VOLTAGE

1) Using color code values and Ohms Law, calculate the value for:
   a) Total resistance = ________________
   b) Total current = ________________
   c) Voltage drop for resistor 1 = __________
   d) Voltage drop for resistor 2 = _________
   e) Voltage drop for resistor 3 = _________

TASK 3 USE A DIGITAL MULTI-METER FOR MEASURING RESISTANCE

1) Using a digital multi-meter measure and record the actual values for:
   a) Resistor 1 = ___________
   b) Resistor 2 = ___________
   c) Resistor 3 = ___________

TASK 4 CONSTRUCT A CIRCUIT AND MEASURE FOR TOTAL RESISTANCE

1) Construct the circuit in Figure 1 and measure the total resistance:
   a) Total resistance = ___________

TASK 5 USING THE BREADBOARD TO MEASURE THE POWER SUPPLY FOR VOLTS D.C.

1) Apply power to the breadboard and adjust the power supply for volts D.C.
2) Measure and record current values at:
   a) point a= __________
   b) point b = __________
   c) point c = __________
   d) point d = __________
   e) point e = __________
3) Does IC + ID + IE = IA = IB? YES NO

TASK 6 MEASURE VOLTAGE DROPS

1) Measure and record the voltage drops across:
   a) resistor 1 = __________
   b) resistor 2 = __________
   c) resistor 3 = __________

TASK 7 MEASURE CURRENT

1) Increase the total voltage to 15 volts and record the value of current:
   a) Total current at 15 volts = ____________
2) Decrease the total voltage to 5 volts and record the value of current:
   a) Total current at 5 volts = ____________

TASK 8 DIFFERENTIATE BETWEEN TWO CURRENT READINGS

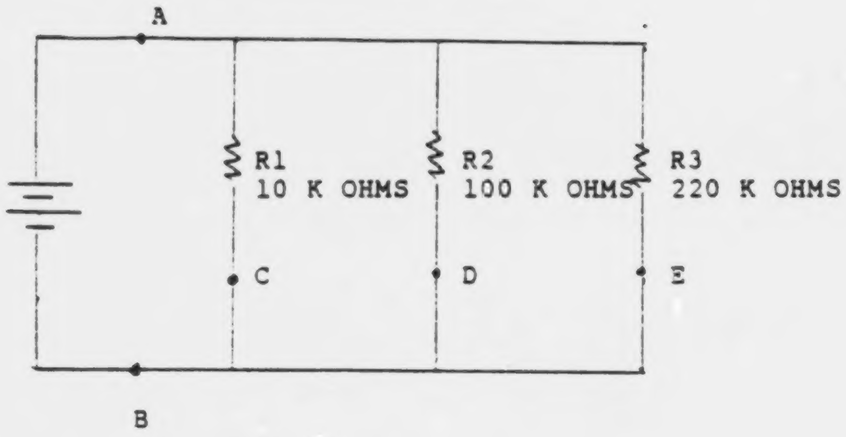
1) Explain the difference between the two current readings.

2) Does total resistance change?

TASK 9 USE THE MEASURED VALUES OF VOLTAGE AND CURRENT TO DETERMINE POWER

1) Calculate power using the measured values of voltage and current for the circuit:
   a) Power across resistor 1 = __________
   b) Power across resistor 2 = __________
   c) Power across resistor 3 = __________
   d) Total power

FIGURE 1


A
R1
10 K OHMS
R2
100 K OHMS
R3
220 K OHMS
C
D
E
B

COMPETENCY EXAMINATION RATING SHEET

Competency: Construct a Direct Current Parallel Series Circuit.

Performance Objective: Given the proper tools, equipment and materials the student will demonstrate the ability to construct a direct current parallel circuit to current industry standards, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Used schematic and selected resistors for a direct current.			
2. Used resistor color code values to determine value for resistance current and voltage.			
3. Measured resistance using a digital multi-meter.			
4. Constructed a circuit and measured for total resistance.			
5. Used the breadboard to measure the power supply for volts D.C.			
6. Measured voltage drops.			
7. Measured current.			
8. Differentiated between two correct readings.			
9. Used the measured values of voltage and current to determine power.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CONSTRUCT A SERIES-PARALLEL RESISTIVE CIRCUIT AND MEASURE VOLTAGE DROPS, CURRENT, RESISTANCE AND COMPUTE POWER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #3

Competency: Construct a Series Parallel Resistive Circuit and Measure Voltage Drops, Current, Resistance and Compute Power.

Performance Objective: Given appropriate tools and equipment, the student will demonstrate the ability to construct a series parallel resistive circuit and measure voltage drops, current, resistance and compute power to current industry standards, achieving 100% mastery on the performance exam.

1) The exam will consist of nine tasks.
2) You will be rated on your ability to perform each of the tasks, to current I.S.A. standards.
3) The maximum time allowed for this exam is 1 hour and 45 minutes.
4) When instructed by the examiner, return the work station to its pretest condition.
5) The student exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials/Equipment Needed:

Schematic diagram
Assorted resistors
Job sheet
Scientific calculator
Pencil
Digital multi-meter
Breadboard
Variable power supply
Jumper wire

Time started:_________
Time finished:_________

COMPETENCY EXAMINATION

CONSTRUCT A SERIES-PARALLEL RESISTIVE CIRCUIT AND MEASURING, VOLTAGE DROPS, CURRENT RESISTANCE AND COMPUTE POWER

PERFORMANCE EXAM:

TASK 1 SELECTING SCHEMATICS

1) Refer to figure 1 and select R1, R2, R3, R4, and R5 from assorted resistors.

TASK 2 USE RESISTOR COLOR CODE VALUES FOR RESISTORS

1) Using color code values for resistors and Ohms Law calculate the value for:
   a) Total resistance = __________
   b) Total current = __________
   c) Voltage drop for resistor 1 = __________
   d) Voltage drop for resistor 2 = __________
   e) Voltage drop for resistor 3 = __________
   f) Voltage drop for resistor 4 = __________
   g) Voltage drop for resistor 5 = __________
   h) Current at Point A = __________
   i) Current at Point B = __________
   j) Current at Point C = __________
   k) Current at Point D = __________
   l) Current at Point E = __________

TASK 3 MEASURING RESISTANCE

1) Using a digital multi-meter measure and record the actual values for:
   a) Resistor 1 = ________
   b) Resistor 2 = ________
   c) Resistor 3 = ________
   d) Resistor 4 = ________
   e) Resistor 5 = ________

TASK 4 CONSTRUCT A CIRCUIT AND MEASURE TOTAL RESISTANCE

1) Construct the circuit in figure 1 and measure total resistance:
   a) Total resistance = ________

TASK 5 APPLY AND ADJUST POWER

1) Apply power to the breadboard and adjust the power supply for 10 volts D.C.

2) Measure and record current values at:
   a) Point A = ________
   b) Point B = ________
   c) Point C = ________
   d) Point D = ________
   e) Point E = ________
3) Does IB + IC + ID = IE ? YES NO

TASK 6 MEASURING VOLTAGE DROPS

1) Measure and record the voltage drops across:
   a) Resistor 1 = ________
   b) Resistor 2 = ________
   c) Resistor 3 = ________
   d) Resistor 4 = ________
   e) Resistor 5 = ________

TASK 7 MEASURING CURRENT

1) Replace Resistor 1 with a 10 K Ohm resistor and record the value of total current.
a) Total current = ________
2) Replace Resistor 5 with a 500 Ohm resistor and record the value of total current.
   a) Total current = ________

TASK 8 VERIFICATION OF OHMS LAW

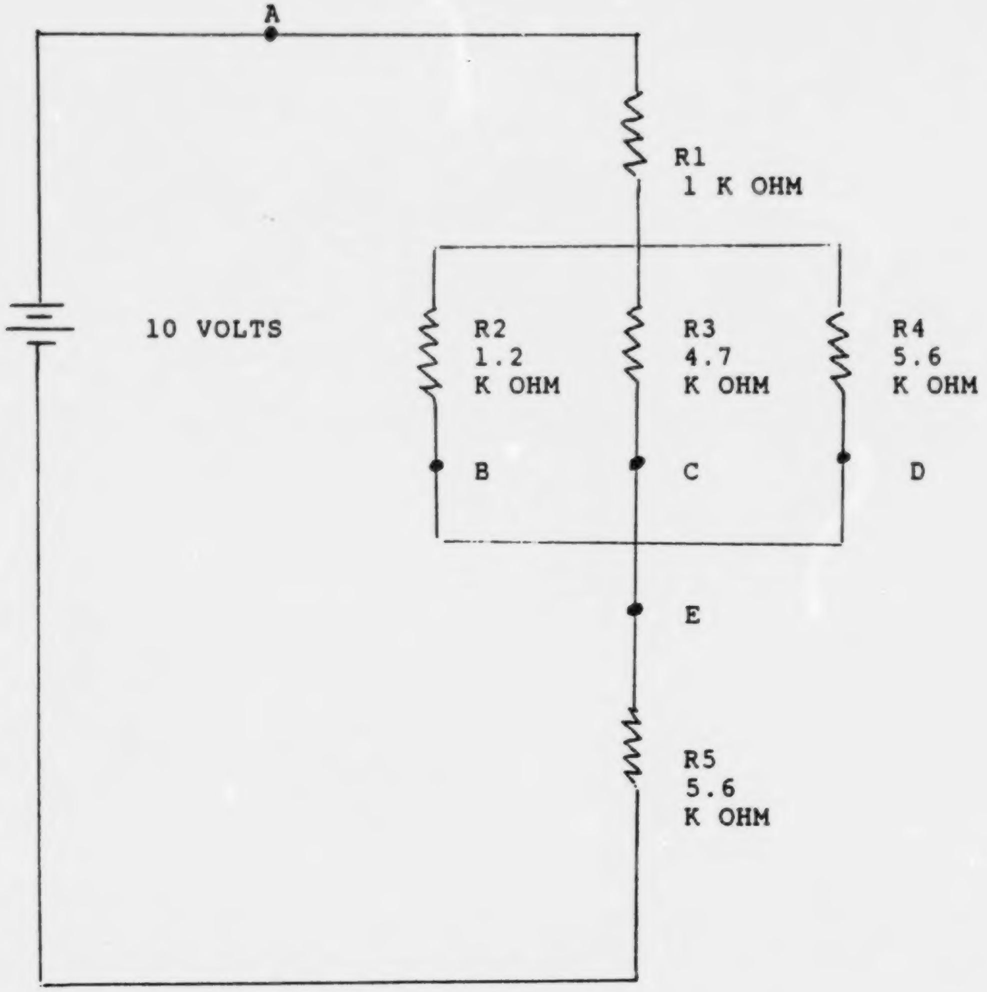
1) Explain the difference between the two current readings.

2) Does total resistance change?

TASK 9 USE THE MEASURED VALUES OF VOLTAGE AND CURRENT TO DETERMINE POWER FOR THE CIRCUIT

1) Calculate power using the measured values of voltage and current for the circuit.
   a) Power across resistor 1 = ________
   b) Power across resistor 2 = ________
   c) Power across resistor 3 = ________
   d) Power across resistor 4 = ________
   e) Power across resistor 5 = ________
   f) Total power = ________

FIGURE 1


A
R1
1 K OHM
10 VOLTS
R2
1.2
K OHM
R3
4.7
K OHM
R4
5.6
K OHM
B
C
D
E
R5
5.6
K OHM

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CONSTRUCT A SERIES-PARALLEL RESISTIVE CIRCUIT AND MEASURE VOLTAGE DROPS, CURRENT, RESISTANCE AND COMPUTE POWER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #3

Competency: Construct a Series Parallel Resistive Circuit and Measure Voltage Drops, Current, Resistance and Compute Power.

Performance Objective: Given appropriate tools and equipment, the student will demonstrate the ability to construct a series parallel resistive circuit and measure voltage drops, current, resistance and compute power to current industry standards, achieving 100% mastery on the performance exam.

1) The maximum time for exam is one hour and 45 minutes.

2) There are nine tasks that the student must perform.

3) Documentation of ratings should be made on individual competency exam rating sheet.

4) Upon completion of the exam, verify that all testing materials are in your possession.

Materials/Equipment Needed:

Schematic diagram
Assorted resistors
Job sheet
Scientific calculator
Pencil
Digital multi-meter
Breadboard
Variable power supply
Jumper wire

Time started:________
Time finished:_______

COMPETENCY EXAMINATION

CONSTRUCT A SERIES-PARALLEL RESISTIVE CIRCUIT AND MEASURING VOLTAGE DROPS, CURRENT, RESISTANCE AND COMPUTE POWER

PERFORMANCE EXAM:

TASK 1 SELECTING SCHEMATICS

1) Refer to figure 1 and select R1, R2, R3, R4, and R5 from assorted resistors.

TASK 2 USE RESISTOR COLOR CODE VALUES FOR RESISTORS

1) Using color code values for resistors and Ohms Law calculate the value for:

a) Total resistance = ___________
b) Total current = ___________
c) Voltage drop for resistor 1 = ___________
d) Voltage drop for resistor 2 = ___________
e) Voltage drop for resistor 3 = ___________
f) Voltage drop for resistor 4 = ___________
g) Voltage drop for resistor 5 = ___________
h) Current at Point A = ___________
i) Current at Point B = ___________
j) Current at Point C = ___________
k) Current at Point D = ___________
i) Current at Point E = ___________

TASK 3 MEASURING RESISTANCE

1) Using a digital multi-meter measure and record the actual values for:

a) Resistor 1 = ________
b) Resistor 2 = ________
c) Resistor 3 = ________
d) Resistor 4 = ________
e) Resistor 5 = ________

TASK 4 CONSTRUCT A CIRCUIT AND MEASURE TOTAL RESISTANCE

1) Construct the circuit in figure 1 and measure total resistance:

a) Total resistance = ________

TASK 5 APPLY AND ADJUST POWER

1) Apply power to the breadboard and adjust the power supply for 10 volts D.C.

2) Measure and record current values at:
   a) Point A = ________
   b) Point B = ________
   c) Point C = ________
   d) Point D = ________
   e) Point E = ________
3) Does IB + IC + ID = IE ? YES NO

TASK 6 MEASURING VOLTAGE DROPS

1) Measure and record the voltage drops across:
   a) Resistor 1 = _________
   b) Resistor 2 = _________
   c) Resistor 3 = _________
   d) Resistor 4 = _________
   e) Resistor 5 = _________

TASK 7 MEASURING CURRENT

1) Replace Resistor 1 with a 10 K Ohm resistor and record the value of total current.
a) Total current = _________
2) Replace Resistor 5 with a 500 Ohm resistor and record the value of total current.
   a) Total current = ________

TASK 8 VERIFICATION OF OHMS LAW

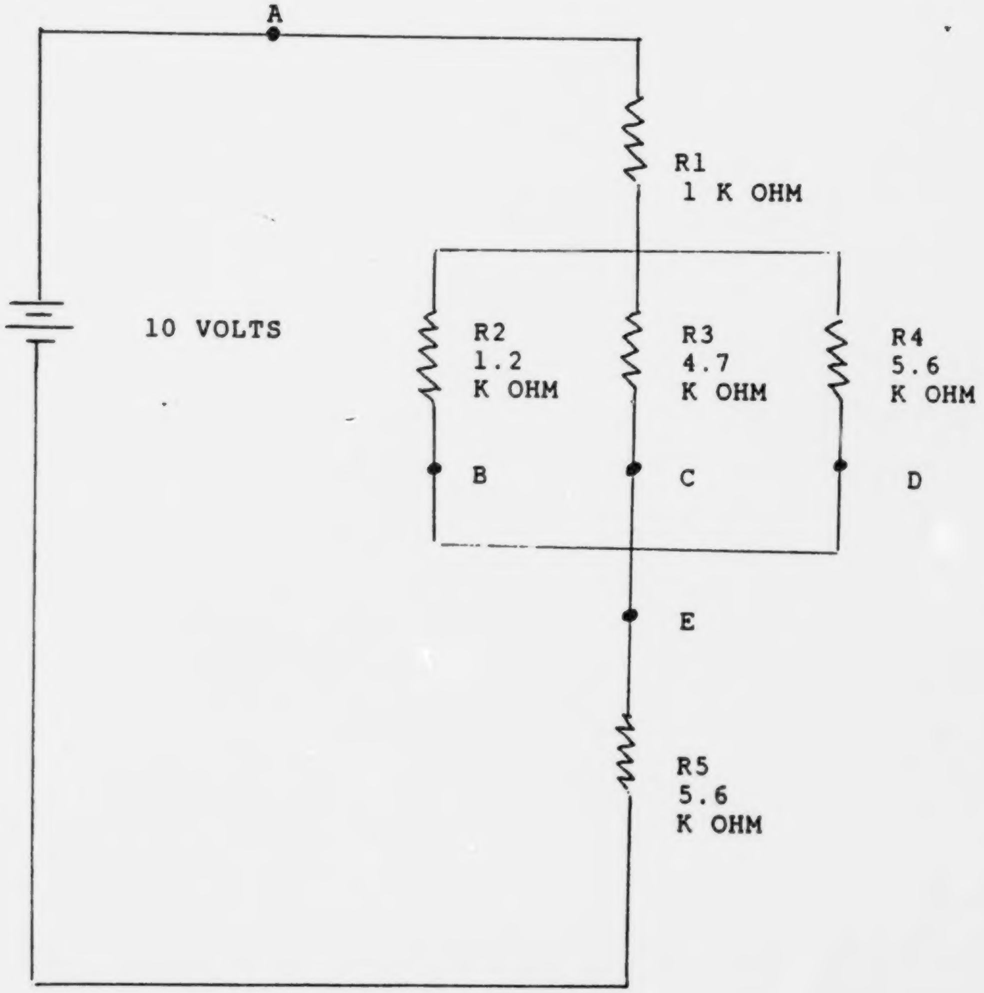
1) Explain the difference between the two current readings.

2) Does total resistance change?

TASK 9 USE THE MEASURED VALUES OF VOLTAGE AND CURRENT TO DETERMINE POWER FOR THE CIRCUIT

1) Calculate power using the measured values of voltage and current for the circuit.
   a) Power across resistor 1 = ________
   b) Power across resistor 2 = ________
   c) Power across resistor 3 = ________
   d) Power across resistor 4 = ________
   e) Power across resistor 5 = ________
   f) Total power = ________

FIGURE 1


A
R1
1 K OHM
10 VOLTS
R2
1.2
K OHM
R3
4.7
K OHM
R4
5.6
K OHM
B
C
D
E
R5
5.6
K OHM

COMPETENCY EXAMINATION RATING SHEET

Competency: Construct a Series Parallel Resistive Circuit and Measure Voltage Drops, Current, Resistance and Compute Power.

Performance Objective: Given appropriate tools and equipment, the student will demonstrate the ability to construct a series parallel resistive circuit and measure voltage drops, current, resistance and compute power to current industry standards, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Read schematics.			
2. Identified resistors color code value.			
3. Measured resistance with DMM.			
4. Constructed circuit and measure total resistance.			
5. Measured voltage and current.			
6. Measured voltage drops.			
7. Measured current.			
8. Verified Ohms Law.			
9. Power calculations.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CONSTRUCT AN ANALYZE A DIRECT CURRENT SERIES RESISTIVE CAPACITIVE CIRCUIT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #4

Competency: Construct and Analyze a Direct Current Series Resistive Capacitive Circuit.

Performance Objective: Given proper equipment and supplies, the student will demonstrate the ability to construct and analyze a direct current, series resistive capacitive circuit to current industry standards, achieving 100% mastery on the performance exam.

1) The exam will consist of five tasks.

2) You will be rated on your ability to perform each of the tasks, to current I.S.A. standards.

3) The maximum time allowed for this exam is 1 hour.

4) When instructed by the examiner, return the work station to its pretest condition.

5) The Student Exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials/Equipment Needed:

Schematic diagram
Assorted resistors
Job sheet
Scientific calculator
Pencil
Digital multi-meter
Breadboard
Variable power supply
Jumper wire
Assorted capacitors
Stock watch
Single pole double throw switch

Time started:__________
Time finished:__________

COMPETENCY EXAMINATION

CONSTRUCT AND ANALYZE A DIRECT CURRENT SERIES RESISTIVE CAPACITIVE CIRCUIT

PERFORMANCE EXAM:

TASK 1 CAPACITOR SELECTION

1) Refer to figure 1 and select a capacitor to build a Series RC circuit with.
   a) Capacitor (C) value = __________

TASK 2 CALCULATE RESISTANCE

1) Calculate the circuit resistance needed to provide a tau (time constant) value of ten seconds.
   a) Time constant (tau) = ________
   b) Resistor (R1) = ________

TASK 3 CIRCUIT CONSTRUCTION

1) Refer to figure 1 and build a Series RC circuit on the breadboard.
2) Set variable voltage source at a value less than or equal to the capacitor rating and record.
   a) Total voltage = _______
3) Observe polarity with the capacitor.

TASK 4 VALUES FOR CAPACITOR CHARGE AND DISCHARGE

1) Calculate and record the values for voltage across the resistor (VR), voltage across the capacitor (VC), and current across the resistor (IR), for 5 time constants during capacitor charge and discharge after attaining full charge.

	CHARGE			DISCHARGE		
TIME	VR	VC	IR	VR	VC	IR
TAU						
2*TAU						
3*TAU						
4*TAU						
5*TAU						

TASK 5 MEASURE THE VALUES OF VOLTAGE

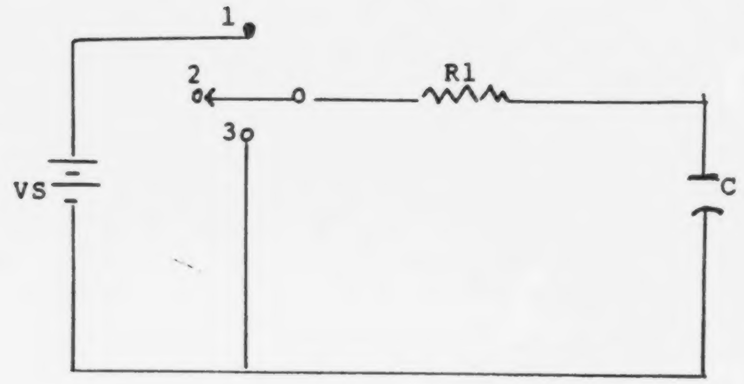
1) With the circuit constructed as shown in figure 1, measure the values of voltage across the resistor (VR), and voltage across the capacitor (VC) , during capacitor charge and discharge.

2) Safely discharge the capacitor before starting to assure accurate readings.

3) Record the readings in the table.

	CHARGE		DISCHARGE	
TIME	VR	VC	VR	VC
TAU				
2*TAU				
3*TAU				
4*TAU				
5*TAU				

FIGURE 1



EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CONSTRUCT AN ANALYZE A DIRECT CURRENT SERIES RESISTIVE CAPACITIVE CIRCUIT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #4

Competency: Construct and Analyze a Direct Current Series Resistive Capacitive Circuit.

Performance Objective: Given proper equipment and supplies, the student will demonstrate the ability to construct and analyze a direct current, series resistive capacitive circuit to current industry standards, achieving 100% mastery on the performance exam.

1) The maximum time for exam will is one hour.

2) There are five tasks that the student must perform.

3) Documentation of ratings should be made on individual competency exam rating sheet.

4) Upon completion of the exam, verify that all testing materials are in your possession.

Materials/Equipment Needed:

- Schematic diagram
- Assorted resistors
- Job sheet
- Scientific calculator
- Pencil
- Digital multi-meter
- Breadboard
- Variable power supply
- Jumper wire
- Assorted capacitors
- Stock watch
- Single pole double throw switch

Time started:__________
Time finished:_________

COMPETENCY EXAMINATION

CONSTRUCT AND ANALYZE A DIRECT CURRENT SERIES RESISTIVE CAPACITIVE CIRCUIT

PERFORMANCE EXAM:

TASK 1 CAPACITOR SELECTION

1) Refer to figure 1 and select a capacitor to build a Series RC circuit with.
   a) Capacitor (C) value = _________

TASK 2 CALCULATE RESISTANCE

1) Calculate the circuit resistance needed to provide a tau (time constant) value of ten seconds.
   a) Time constant (tau) = ________
   b) Resistor (R1) = ________

TASK 3 CIRCUIT CONSTRUCTION

1) Refer to figure 1 and build a Series RC circuit on the breadboard.
2) Set variable voltage source at a value less than or equal to the capacitor rating and record.
   a) Total voltage = ________
3) Observe polarity with the capacitor.

TASK 4 VALUES FOR CAPACITOR CHARGE AND DISCHARGE

1) Calculate and record the values for voltage across the resistor (VR), voltage across the capacitor (VC), and current across the resistor (IR), for 5 time constants during capacitor charge and discharge after attaining full charge.

	CHARGE			DISCHARGE		
TIME	VR	VC	IR	VR	VC	IR
TAU						
2*TAU						
3*TAU						
4*TAU						
5*TAU						

TASK 5 MEASURE THE VALUES OF VOLTAGE

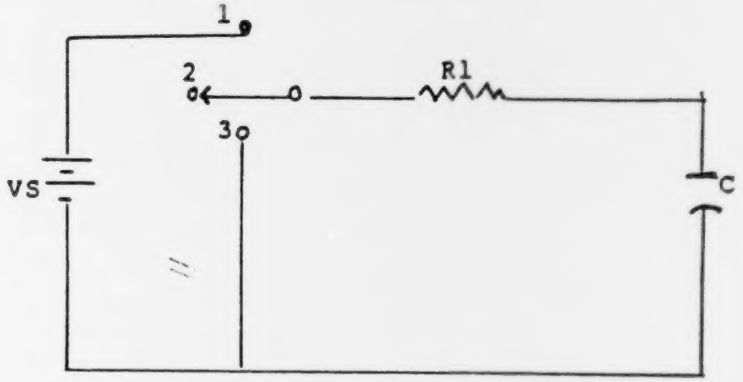
1) With the circuit constructed as shown in figure 1, measure the values of voltage across the resistor (VR), and voltage across the capacitor (VC) , during capacitor charge and discharge.

2) Safely discharge the capacitor before starting to assure accurate readings.

3) Record the readings in the table.

	CHARGE		DISCHARGE	
TIME	VR	VC	VR	VC
TAU				
2*TAU				
3*TAU				
4*TAU				
5*TAU				

FIGURE 1



STUDENT EXAMINATION RATING SHEET

Competency: Construct and Analyze a Direct Current Series Resistive Capacitive Circuit.

Performance Objective: Given proper equipment and supplies, the student will demonstrate the ability to construct and analyze a direct current, series resistive capacitive circuit to current industry standards, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Resistor selected.			
2. Circuit constructed.			
3. Variable calculations.			
4. Variable measurements.			
5. Capacitor selection.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

DETERMINING ALTERNATING CURRENT
TIME-FREQUENCY VOLTAGE MEASUREMENT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #5

Competency: Determining Alternating Current Time-Frequency-Voltage Measurement.

Performance Objective: Given the proper tools and equipment, the student will demonstrate the ability to measure the time, frequency, and voltage from an oscilloscope display to current I.S.A. standards, achieving 100% mastery on the performance test.

1) The exam consists of five tasks.

2) You will be rated on your ability to perform each of the tasks, to current I.S.A. standards.

3) The maximum time allowed for the exam is 20 minutes.

4) When instructed by the examiner, return the work station to its pretest condition.

5) The student exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials Needed:

Variable A.C. generator
Oscilloscope
Calculator

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

DETERMINING ALTERNATING CURRENT TIME-FREQUENCY-VOLTAGE MEASUREMENT

PERFORMANCE EXAM:

TASK 1 PERIOD MEASUREMENT

1) Randomly set the generator value.
2) Attach the oscilloscope leads.
3) Adjust the Time/Division controls until a useable sine wave appears on screen.
4) Measure and record the period.

TASK 2 FREQUENCY MEASUREMENT

1) Using the sine wave displayed for TASK 1 measure and record the frequency of the sine wave.

TASK 3 PEAK TO PEAK VOLTAGE MEASUREMENT

1) Using the sine wave displayed and the VOLTS/DIVISION controls, measure and record the PEAK TO PEAK voltage displayed.

TASK 4 PEAK VOLTAGE MEASUREMENT

1) Using the sine wave displayed and the VOLTS/DIVISION controls, measure and record the PEAK VOLTAGE.

TASK 5 RMS VOLTAGE CALCULATIONS

1) Using the value measured in TASK 4 calculate and record the RMS voltage the sine wave represents.

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

DETERMINING ALTERNATING CURRENT TIME-FREQUENCY VOLTAGE MEASUREMENT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #5

Competency: Determining Alternating Current Time-Frequency-Voltage Measurement.

Performance Objective: Given the proper tools and equipment, the student will demonstrate the ability to measure the time, frequency, and voltage from an oscilloscope display to current I.S.A. standards, achieving 100% mastery on the performance test.

1) The maximum time allowed for the exam is 20 minutes.
2) There are five tasks that the student must perform.
3) Prepare according to given instruction or formula.
4) Upon completion of the exam, verify that all testing materials and equipment have been returned to pretest condition.
5) Clarify any questions before the exam begins.
6) Record all ratings on the individual student competency rating sheet.

Materials Needed:

Variable A.C. generator
Oscilloscope
Calculator

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

DETERMINING ALTERNATING CURRENT TIME-FREQUENCY-VOLTAGE MEASUREMENT

PERFORMANCE EXAM:

TASK 1 PERIOD MEASUREMENT

1) Randomly set the generator value.
2) Attach the oscilloscope leads.
3) Adjust the Time/Division controls until a useable sine wave appears on screen.
4) Measure and record the period.

TASK 2 FREQUENCY MEASUREMENT

1) Using the sine wave displayed for TASK 1 measure and record the frequency of the sine wave.

TASK 3 PEAK TO PEAK VOLTAGE MEASUREMENT

1) Using the sine wave displayed and the VOLTS/DIVISION controls, measure and record the PEAK TO PEAK voltage displayed.

TASK 4 PEAK VOLTAGE MEASUREMENT

1) Using the sine wave displayed and the VOLTS/DIVISION controls, measure and record the PEAK VOLTAGE.

TASK 5 RMS VOLTAGE CALCULATIONS

1) Using the value measured in TASK 4 calculate and record the RMS voltage the sine wave represents.

COMPETENCY EXAMINATION RATING SHEET

Competency: Determining Alternating Current Time-Frequency-Voltage Measurement.

Performance Objective: Given the proper tools and equipment, the student will demonstrate the ability to measure the time, frequency, and voltage from an oscilloscope display to current I.S.A. standards, achieving 100% mastery on the performance test.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Period measurement.			
2. Frequency measurement.			
3. Peak to peak voltage measurement.			
4. Peak voltage measurement.			
5. RMS voltage calculation.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

IDENTIFICATION OF OPENS IN OVERCURRENT PROTECTION

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #6

Competency: Identification of Opens in Overcurrent Protection.

Performance Objective: Given the proper tools and equipment the student will demonstrate the ability to identify opens in a circuits overcurrent protection device to current industry standards, achieving 100% mastery on the performance exam.

1) The exam consists of five tasks.

2) You will be rated on your ability to perform each of the tasks, to current industry standards.

3) The maximum time allowed for the exam is 10 minutes.

4) When instructed by the examiner, return the work station to its pre-exam condition.

5) The student exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials/Equipment Needed:

Voltmeter
Three phase fuseable disconnect switch
Fuses

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

IDENTIFICATION OF OPENS IN OVERCURRENT PROTECTION

PERFORMANCE EXAM:

TASK 1 MEASURE LINE SIDE VOLTAGE

1) Measure and record the voltage between each phase and ground.

2) Measure and record the voltage between phases.

TASK 2 MEASURE LOAD SIDE VOLTAGE

1) Measure and record the voltage between each phase and ground.

2) Measure and record the voltage between phases.

TASK 3 COMPARE MEASURED VOLTAGES AND IDENTIFY WHICH OVERCURRENT DEVISE IS OPEN.

TASK 4 DISCONNECT THE CIRCUIT LOAD.

TASK 5 REPLACE THE OPEN FUSE.

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

IDENTIFICATION OF OPENS IN OVERCURRENT PROTECTION

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #6

Competency: Identification of Opens in Overcurrent Protection.

Performance Objective: Given the proper tools and equipment the student will demonstrate the ability to identify opens in a circuits overcurrent protection device to current industry standards, achieving 100% mastery on the performance exam.

1) The maximum time for exam is 10 minutes.

2) There are five tasks that the student must perform.

3) Documentation of ratings should be made on individual competency exam rating sheet.

4) Upon completion of the exam, verify that all testing materials are in your possession.

Materials/Equipment Needed:

Voltmeter
Three phase fuseable disconnect switch
Fuses

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

IDENTIFICATION OF OPENS IN OVERCURRENT PROTECTION

PERFORMANCE EXAM:

TASK 1 MEASURE LINE SIDE VOLTAGE

1) Measure and record the voltage between each phase and ground.

2) Measure and record the voltage between phases.

TASK 2 MEASURE LOAD SIDE VOLTAGE

1) Measure and record the voltage between each phase and ground.

2) Measure and record the voltage between phases.

TASK 3 COMPARE MEASURED VOLTAGES AND IDENTIFY WHICH OVERCURRENT DEVISE IS OPEN.

TASK 4 DISCONNECT THE CIRCUIT LOAD.

TASK 5 REPLACE THE OPEN FUSE.

COMPETENCY EXAMINATION RATING SHEET

Competency: Identification of Opens in Overcurrent Protection.

Performance Objective: Given the proper tools and equipment the student will demonstrate the ability to identify opens in a circuits overcurrent protection device to current industry standards, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Measured line voltage.			
2. Measured load voltage.			
3. Identified opening.			
4. Disconnected load.			
5. Replaced fuse.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TROUBLESHOOTING AND REPAIRING FLUORESCENT LIGHTING

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #7

Competency: Troubleshooting and Repairing Fluorescent Lighting.

Performance Objective: Given the proper tools and equipment, the student will demonstrate the ability to identify and repair problems in a fluorescent light fixture to National Electric Code standards, achieving 100% mastery on the performance exam.

1) The exam consists of seven tasks.

2) You will be rated on your ability to perform each of the tasks, to current National Electric Code standards.

3) The maximum time allowed for the exam is 30 minutes.

4) When instructed by the examiner, return the work station to its pre-exam condition.

5) The Student Exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials/Equipment Needed:

Fluorescent lamps
Lampholders
Ballast
Solderless connectors
Voltmeter
Standard screwdriver
Phillips screwdriver
Adjustable wrench
Nut driver set
Wire stripper

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

TROUBLESHOOTING AND REPAIRING FLUORESCENT LIGHTING

**** WARNING CONTACT WITH LIVE ELECTRICAL PARTS WILL BE FATAL****
****USE CAUTION****

PERFORMANCE EXAM:

TASK 1 CHECK FLUORESCENT FIXTURE FOR DAMAGE

1) Check the fixture for exterior damage such as broken, lamps, broken lampholders, separation from power circuit, leaking ballast fluids, etc. If any of these are present then proceed to the appropriate job.

TASK 2 CHECK SOURCE VOLTAGE

1) Remove the ballast cover and test the switch leg, and ground for appropriate voltage and continuity. If either is missing repair and test the fixture, otherwise continue to the next test.

TASK 3 CHECK LAMPS

1) Remove the lamps, and check for cracks or burn marks (discoloration). Replace with new lamps. Test the fixture.

TASK 4 CHECK OVERCURRENT PROTECTION DEVICE IN FIXTURE

1) If the fixture is equipped with an overcurrent device in series with the lampholders, check for a blown fuse, or burned out starter. Replace as needed. Test the fixture.

TASK 5 CHECK LAMPHOLDERS

1) Visually inspect the lampholders for impact marks, replace if cracked or chipped.

2) Inspect the conductor connections to the lampholders for loose wires or improper connections, reconnect or rewire as needed.

3) Test the fixture.

TASK 6 REPLACE BALLAST

1) Disconnect the ballast line side.
2) Disconnect the ballast load side.
3) Remove ballast from fixture.
4) Select appropriate replacement ballast.
5) Attach new ballast to fixture.
6) Splice on load side.
7) Splice on line side.
8) Dispose of old ballast according to appropriate environmental regulations.
9) Test the fixture.

TASK 7 TEST THE FIXTURE

1) Check splices for exposed wire and correct as needed.
2) Check to see any overcurrent device is functional.
3) Check to see all covers are in place.
4) Check to see all lamps are properly installed.
5) Check to see all lampholders are in working order.
6) Apply power to fixture.

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TROUBLESHOOTING AND REPAIRING

FLUORESCENT LIGHTING

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #7

Competency: Troubleshooting and Repairing Fluorescent Lighting.

Performance Objective: Given the proper tools and equipment, the student will demonstrate the ability to identify and repair problems in a fluorescent light fixture to National Electric Code standards, achieving 100% mastery on the performance exam.

1) The maximum time for exam is 30 minutes.

2) There are seven tasks that the student must perform.

3) Documentation of ratings should be made on individual competency exam rating sheet.

4) Upon completion of the exam, verify that all testing materials are in your possession.

Materials/Equipment Needed:

Fluorescent lamps
Lampholders
Ballast
Solderless connectors
Voltmeter
Standard screwdriver
Phillips screwdriver
Adjustable wrench
Nut driver set
Wire stripper

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

TROUBLESHOOTING AND REPAIRING FLUORESCENT LIGHTING

**** WARNING CONTACT WITH LIVE ELECTRICAL PARTS WILL BE FATAL****
****USE CAUTION****

PERFORMANCE EXAM:

TASK 1 CHECK FLUORESCENT FIXTURE FOR DAMAGE

1) Check the fixture for exterior damage such as broken, lamps, broken lampholders, separation from power circuit, leaking ballast fluids, etc. If any of these are present then proceed to the appropriate job.

TASK 2 CHECK SOURCE VOLTAGE

1) Remove the ballast cover and test the switch leg, and ground for appropriate voltage and continuity. If either is missing repair and test the fixture, otherwise continue to the next test.

TASK 3 CHECK LAMPS

1) Remove the lamps, and check for cracks or burn marks (discoloration). Replace with new lamps. Test the fixture.

TASK 4 CHECK OVERCURRENT PROTECTION DEVICE IN FIXTURE

1) If the fixture is equipped with an overcurrent device in series with the lampholders, check for a blown fuse, or burned out starter. Replace as needed. Test the fixture.

TASK 5 CHECK LAMPHOLDERS

1) Visually inspect the lampholders for impact marks, replace if cracked or chipped.

2) Inspect the conductor connections to the lampholders for loose wires or improper connections, reconnect or rewire as needed.

3) Test the fixture.

TASK 6 REPLACE BALLAST

1) Disconnect the ballast line side.
2) Disconnect the ballast load side.
3) Remove ballast from fixture.
4) Select appropriate replacement ballast.
5) Attach new ballast to fixture.
6) Splice on load side.
7) Splice on line side.
8) Dispose of old ballast according to appropriate environmental regulations.
9) Test the fixture.

TASK 7 TEST THE FIXTURE

1) Check splices for exposed wire and correct as needed.
2) Check to see any overcurrent device is functional.
3) Check to see all covers are in place.
4) Check to see all lamps are properly installed.
5) Check to see all lampholders are in working order.
6) Apply power to fixture.

COMPETENCY EXAMINATION RATING SHEET

Competency: Troubleshooting and Repairing Fluorescent Lighting.

Performance Objective: Given the proper tools and equipment, the student will demonstrate the ability to identify and repair problems in a fluorescent light fixture to National Electric Code standards, achieving 100% mastery on the performance exam.

STUDENT ______________________ Competency Mastered YES ____ NO ____

EXAMINER ______________________ Date of Rating ______________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Visually identified potential trouble spots.			
2. Properly checked power supply for problems.			
3. Replaced lamps if necessary.			
4. Checked overcurrent device for continuity.			
5. Identified damage and/or improper connections to lampholders.			
6. Replaced ballast.			
7. Tested fixture.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TROUBLESHOOTING HIGH PRESSURE SODIUM LIGHTING FIXTURES

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #8

Competency: Troubleshooting High Pressure Sodium Lighting Fixtures.

Performance Objective: Given the proper equipment and supplies, the student will demonstrate the ability to troubleshoot and repair a high pressure sodium lighting fixture, to current industry standards, achieving 100% mastery on the performance exam.

1) The test consists of five tasks.

2) You will be rated on your ability to perform each of the tasks, to current industry standard.

3) The maximum time allowed for the exam is 30 minutes.

4) When instructed by the examiner, return the work station to its pre-exam condition.

5) The student exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials/Equipment Needed:

Lamps
Starter
Capacitor
Ballast
Photocell
Multi-meter
Screwdriver
Multi-purpose tool

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

TROUBLESHOOTING HIGH PRESSURE SODIUM LIGHT FIXTURES

PERFORMANCE EXAM:

TASK 1 THE LAMP WILL NOT LIGHT

1) Check for broken or loose electrical connections, and burned or damaged components.
2) Check for faulty lamp. Replace lamp.
   a) broken electrodes
   b) poor connections
   c) Misaligned arc tube
3) Check supply voltage
4) Check photocell

TASK 2 THE FIXTURE BURNS NIGHT AND DAY

1) Replace photocell

TASK 3 FIXTURE OUTPUT TOO DIM

1) Check ballast for proper connections
2) Check supply voltage
3) Incorrect capacitor or capacitor not correctly wired.
4) Incorrect lamp

TASK 4 FIXTURE GOES OFF AND COMES BACK ON REPEATEDLY (CYCLING).

1) Replace lamp
2) Poor wiring connections
3) Faulty or misaligned photocell
4) Ballast failure
5) Capacitor failure
6) Excess vibration effecting fixture

TASK 5 FIXTURE GOES OFF SHORTLY AFTER BEING ENERGIZED

1) Faulty ballast or ballast connections
2) Faculty capacitor or capacitor connections
3) Faculty fixture wiring

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TROUBLESHOOTING HIGH PRESSURE SODIUM LIGHTING FIXTURES

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #8

Competency: Troubleshooting High Pressure Sodium Lighting Fixtures.

Performance Objective: Given the proper equipment and supplies, the student will demonstrate the ability to troubleshoot and repair a high pressure sodium lighting fixture, to current industry standards, achieving 100% mastery on the performance exam.

1) The maximum time for exam is 30 minutes.

2) There are five tasks that the student must perform.

3) Documentation of ratings should be made on individual competency exam rating sheet.

4) Upon completion of the exam, verify that all testing materials are in your possession.

Materials/Equipment Needed:

Lamps
Starter
Capacitor
Ballast
Photocell
Multi-meter
Screwdriver
Multi-purpose tool

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

TROUBLESHOOTING HIGH PRESSURE SODIUM LIGHT FIXTURES

PERFORMANCE EXAM:

TASK 1 THE LAMP WILL NOT LIGHT

1) Check for broken or loose electrical connections, and burned or damaged components.
2) Check for faulty lamp. Replace lamp.
    - a) broken electrodes
    - b) poor connections
    - c) Misaligned arc tube
3) Check supply voltage
4) Check photocell

TASK 2 THE FIXTURE BURNS NIGHT AND DAY

1) Replace photocell

TASK 3 FIXTURE OUTPUT TOO DIM

1) Check ballast for proper connections
2) Check supply voltage
3) Incorrect capacitor or capacitor not correctly wired.
4) Incorrect lamp

TASK 4 FIXTURE GOES OFF AND COMES BACK ON REPEATEDLY (CYCLING).

1) Replace lamp
2) Poor wiring connections
3) Faulty or misaligned photocell
4) Ballast failure
5) Capacitor failure
6) Excess vibration effecting fixture

TASK 5 FIXTURE GOES OFF SHORTLY AFTER BEING ENERGIZED

1) Faulty ballast or ballast connections
2) Faculty capacitor or capacitor connections
3) Faculty fixture wiring

COMPETENCY EXAMINATION RATING SHEET

Competency: Troubleshooting High Pressure Sodium Lighting Fixtures.

Performance Objective: Given the proper equipment and supplies, the student will demonstrate the ability to troubleshoot and repair a high pressure sodium lighting fixture, to current industry standards, achieving 100% mastery on the performance exam.

STUDENT ______________________________ **Competency Mastered YES** _____ **NO** ____

EXAMINER ______________________________ **Date of Rating** ________________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	**No. of Attempts**	**Completion Date**
1. Identified shorts or opens in lamp.			
2. Identified shorts or opens in photocell.			
3. Properly installed a step up transformer.			
4. Properly installed a capacitor.			
5. Properly installed a starter.			
6. Properly terminated conductors.			
7. Properly identified problem.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

INSTALL AND TEST A TRANSFORMER CIRCUIT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #9

Competency: Install and Test a Transformer Circuit.

Performance Objective: Given proper tools and equipment, the student will demonstrate the ability to install and test a transformer circuit to current industry standards, achieving 100% mastery on the performance exam.

1) The test consists of five tasks.

2) You will be rated on your ability to perform each of the tasks, to current I.S.A. standards.

3) The maximum time allowed for the exam is 20 minutes.

4) When instructed by the examiner, return the work station to its pre-exam condition.

5) The student exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials/Equipment Needed:

120 V/16 VA step down transformer
Dual bell chime
Bell wire
2-single pole pushbutton switches
Junction box containing 120 V power supply
Mounting screws
Multi-meter
Screwdrivers
Pliers
Wrenches
Solderless connectors
Wire strippers

Time started: ___________
Time finished: __________

COMPETENCY EXAMINATION

INSTALL AND TEST A TRANSFORMER CIRCUIT

PERFORMANCE EXAM:

TASK 1 MOUNT TRANSFORMER

1) Install the 120 V/16 VA stepdown transformer at the junction box containing the 120 V power supply.

2) Connect the line side of the transformer.

TASK 2 MOUNT DUAL BELL CHIME

1) Mount the chines.
2) Install bell wire from the chime to the transformer.
3) Connect 1 bell wire lead to the common terminal of the chimes.

TASK 3 MOUNT FRONT DOOR PUSHBUTTON

1) Install bell wire from chimes to pushbutton.
2) Attach bell wire conductors to pushbutton terminals.
3) Attach bell wire conductor to front door terminal on chimes.
4) Mount front door pushbutton.

TASK 4 MOUNT BACK DOOR PUSHBUTTON

1) Install bell wire from chimes to pushbutton.
2) Attach bell wire conductors to pushbutton terminals.
3) Attach bell wire conductors to back door terminal on chimes.
4) Mount back door pushbutton.

TASK 5 TEST SIGNALING CIRCUIT

1) Attach remaining lead from front and rear pushbutton conductor to common hot lead off of transformer.
2) Apply power to system.
3) Test.

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

INSTALL AND TEST A TRANSFORMER CIRCUIT

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #9

Competency: Install and Test a Transformer Circuit.

Performance Objective: Given proper tools and equipment, the student will demonstrate the ability to install and test a transformer circuit to current industry standards, achieving 100% mastery on the performance exam.

1) The maximum time for exam is 20 minutes.

2) There are five tasks that the student must perform.

3) Documentation of ratings should be made on individual competency exam rating sheet.

4) Upon completion of the exam, verify that all testing materials are in your possession.

Materials/Equipment Needed:

120 V/16 VA step down transformer
Dual bell chime
Bell wire
2-single pole pushbutton switches
Junction box containing 120 V power supply
Mounting screws
Multi-meter
Screwdrivers
Pliers
Wrenches
Solderless connectors
Wire strippers

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

INSTALL AND TEST A TRANSFORMER CIRCUIT

PERFORMANCE EXAM:

TASK 1 MOUNT TRANSFORMER

1) Install the 120 V/16 VA stepdown transformer at the junction box containing the 120 V power supply.

2) Connect the line side of the transformer.

TASK 2 MOUNT DUAL BELL CHIME

1) Mount the chines.
2) Install bell wire from the chime to the transformer.
3) Connect 1 bell wire lead to the common terminal of the chimes.

TASK 3 MOUNT FRONT DOOR PUSHBUTTON

1) Install bell wire from chimes to pushbutton.
2) Attach bell wire conductors to pushbutton terminals.
3) Attach bell wire conductor to front door terminal on chimes.
4) Mount front door pushbutton.

TASK 4 MOUNT BACK DOOR PUSHBUTTON

1) Install bell wire from chimes to pushbutton.
2) Attach bell wire conductors to pushbutton terminals.
3) Attach bell wire conductors to back door terminal on chimes.
4) Mount back door pushbutton.

TASK 5 TEST SIGNALING CIRCUIT

1) Attach remaining lead from front and rear pushbutton conductor to common hot lead off of transformer.
2) Apply power to system.
3) Test.

COMPETENCY EXAMINATION RATING SHEET

Competency: Install and Test a Transformer Circuit.

Performance Objective: Given proper tools and equipment, the student will demonstrate the ability to install and test a transformer circuit to current industry standards, achieving 100% mastery on the performance exam.

STUDENT ______________________ Competency Mastered YES ____ NO ____

EXAMINER ______________________ Date of Rating ______________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Transformer installated.			
2. Bell installated.			
3. Front pushbutton installated.			
4. Rear pushbutton installated.			
5. Tested transformer circuit.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

USE A.C. TEST EQUIPMENT TO LOCATE OPENS AND SHORTS IN A MOTOR CONTROLLER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #10

Competency: Use A.C. Test Equipment to Locate Opens and Shorts in a Motor Controller.

Performance Objective: Given proper tools and equipment, the student will demonstrate the ability to use test equipment to find opens and shorts in a motor controller to current industry standards, achieving 100% mastery on the performance exam.

1) The test will consists of seven tasks.

2) You will be rated on your ability to perform each of the tasks, to current I.S.A. standards.

3) The maximum time allowed for the exam is one hour.

4) When instructed by the examiner, return the work station to its pre-exam condition.

5) The student exam booklet, any scrap worksheets, and all equipment must be turned in to the examiner and checked before you are given permission to leave the exam area.

Materials/Equipment Needed:

Motor circuit
Motor controller
Motor
Multi-meter
Screwdrivers
Pliers
Wrenches
Electrical cleaner
Heating elements
Holding coils
Contacts

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

USE A.C. TEST EQUIPMENT TO LOCATE OPENS AND SHORTS IN A MOTOR CONTROLLER

PERFORMANCE EXAM:

TASK 1 DETERMINE WHETHER THE FAULT IS IN THE MOTOR OR THE CONTROLLER.

1) Connect the multi-meter to the motor leads and energize the circuit, if there is no current, the trouble lies in the controller.

TASK 2 CHECK FOR GROUNDS OR SHORTS

1) If overcurrent protection is activated when the START button is pressed, check for shorts or grounds in the contacts or coils.

TASK 3 IS THE COIL SHORTED?

1) Check for overcurrent due to mechanical problems.
2) Check for excess voltage.

TASK 4 IF THE MAGNET IS NOISY

1) Clean the core.
2) Check for a broken shaded pole.

TASK 5 IF THE CONTACTS DO NOT CLOSE WHEN THE START BUTTON IS PRESSED.

1) Check open terminal connections.
2) Check open overload relay.
3) Check for low voltage.
4) Check for control button opens.
5) Check for open coil.
6) Check for shorted coil.

TASK 6 IF THE CONTACTS OPEN AFTER THE START BUTTON HAS BEEN RELEASED.

1) Check axillary contacts for mechanical dependability.
2) Check for proper connections of axillary contacts.

TASK 7 IF THE MOTOR DOES NOT START WHEN THE MAIN CONTACTS CLOSE.

1) Check heaters.
2) Check contact points.
3) Check loose connections and splices.
4) Check mechanical trouble such as dirt of worn springs.
5) Check for opens in the transformer.

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

USE A.C. TEST EQUIPMENT TO LOCATE OPENS AND SHORTS IN A MOTOR CONTROLLER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #10

Competency: Use A.C. Test Equipment to Locate Opens and Shorts in a Motor Controller.

Performance Objective: Given proper tools and equipment, the student will demonstrate the ability to use test equipment to find opens and shorts in a motor controller to current industry standards, achieving 100% mastery on the performance exam.

1) The maximum time for exam is one hour.
2) There are seven tasks that the student must perform.
3) Documentation of ratings should be made on individual competency exam rating sheet.
4) Upon completion of the exam, verify that all testing materials are in your possession.

Materials/Equipment Needed:

Motor circuit
Motor controller
Motor
Multi-meter
Screwdrivers
Pliers
Wrenches
Electrical cleaner
Heating elements
Holding coils
Contacts

Time started: __________
Time finished: __________

COMPETENCY EXAMINATION

USE A.C. TEST EQUIPMENT TO LOCATE OPENS AND SHORTS IN A MOTOR CONTROLLER

PERFORMANCE EXAM:

TASK 1 DETERMINE WHETHER THE FAULT IS IN THE MOTOR OR THE CONTROLLER.

1) Connect the multi-meter to the motor leads and energize the circuit, if there is no current, the trouble lies in the controller.

TASK 2 CHECK FOR GROUNDS OR SHORTS

1) If overcurrent protection is activated when the START button is pressed, check for shorts or grounds in the contacts or coils.

TASK 3 IS THE COIL SHORTED?

1) Check for overcurrent due to mechanical problems.
2) Check for excess voltage.

TASK 4 IF THE MAGNET IS NOISY

1) Clean the core.
2) Check for a broken shaded pole.

TASK 5 IF THE CONTACTS DO NOT CLOSE WHEN THE START BUTTON IS PRESSED.

1) Check open terminal connections.
2) Check open overload relay.
3) Check for low voltage.
4) Check for control button opens.
5) Check for open coil.
6) Check for shorted coil.

TASK 6 IF THE CONTACTS OPEN AFTER THE START BUTTON HAS BEEN RELEASED.

1) Check axillary contacts for mechanical dependability.
2) Check for proper connections of axillary contacts.

TASK 7 IF THE MOTOR DOES NOT START WHEN THE MAIN CONTACTS CLOSE.

1) Check heaters.
2) Check contact points.
3) Check loose connections and splices.
4) Check mechanical trouble such as dirt of worn springs.
5) Check for opens in the transformer.

COMPETENCY EXAMINATION RATING SHEET

Competency: Use A.C. Test Equipment to Locate Opens and Shorts in a Motor Controller.

Performance Objective: Given proper tools and equipment, the student will demonstrate the ability to use test equipment to find opens and shorts in a motor controller to current industry standards, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Determined whether a motor or controller fault exist.			
2. Identified grounds or shorts.			
3. Checked coil operation.			
4. Checked magnet operation.			
5. Checked mechanical functions of contractor.			
6. Checked electro-mechanical operation of auxiliary contacts.			
7. Checked electrical functions of contractor.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TEST SEMICONDUCTOR DIODES AND BIPOLAR JUNCTION TRANSISTOR, TO IDENTIFY DEFECTS

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #11

Competency: Test Semiconductor Diodes and Bipolar Junction Transistor, to Identify Defects.

Performance Objective: Demonstrate the ability to test semiconductor diodes and bipolar junction transistor,to identify defects according to departmental standards, achieving 100% mastery on the performance exam.

1) This exam consists of three tasks:

    a. General Knowledge of Semiconductors
    b. Testing Semiconductor Diodes
    c. Testing Bipolar Junction Transistors

2) You will be rated on your ability to perform each of the tasks to established departmental standards.

3) The maximum time allowed for the exam is 1 hour.

4) When instructed by the examiner, return the work station to its pre-exam condition.

5) The student exam booklet, any scrap worksheets, and all equipment must be returned to the examiner before you are allowed to leave the exam area. The results of the exam will be discussed at the conclusion of the exam.

6) After you have read these instructions, inform the examiner that you are ready to begin the exam.

Equipment/Materials Needed:

1 DMM
3 General purpose diodes
3 Bipolar junction transistors

Time started: _________
Time finished: _________

COMPETENCY EXAMINATION

SEMICONDUCTOR DIODES AND BIPOLAR JUNCTION TRANSISTORS TO IDENTIFY DEFECTS

PERFORMANCE EXAM:

TASK 1 ANSWER THE FOLLOWING QUESTIONS TO TEST YOUR GENERAL KNOWLEDGE OF SEMICONDUCTORS: How Do You:

1) Identify the cathode end of a diode.

2) Identify the emitter lead of a transistor on a schematic diagram.

3) T F zener diodes can identified just by looking at them.

4) How many resistance measurements must be made to test a transistor?

TASK 2 TEST EACH DIODE AT THE WORK STATION, INDICATE THE CONDITION OF THE DEVICE AS GOOD OR BAD IN THE SPACE PROVIDED.

1) Diode #1: Forward Resistance _________ Reverse Resistance _____

Condition of Component **Good** **Bad**

If the component checks bad, what type of defect is indicated?

2) Diode #2: Forward Resistance ________ Reverse Resistance _____

Condition of Component **Good** **Bad**

If the component checks bad, what type of defect is indicated?

3) Diode #3: Forward Resistance ________ Reverse Resistance ______

If the component checks bad, what type of defect is indicated?

TASK 3 TEST EACH TRANSISTOR AT THE WORK STATION. RECORD THE READINGS IN THE SPACE PROVIDED. INDICATE THE CONDITION OF THE COMPONENT AS GOOD OR BAD. IF THE DEVICE IS DEFECTIVE, INDICATE THE NATURE OF THE DEFECT.

TRANSISTOR #1

EB-Forward Resistance _________
EB-Reverse Resistance _________
CB-Forward Resistance _________
CB-Reverse Resistance _________
CE-_______ Resistance _________

Component Condition Good Bad Nature of Defect if Bad _________

TRANSISTOR #2

EB-Forward Resistance _______
EB-Reverse Resistance _______
CB-Forward Resistance _______
CB-Reverse Resistance _______
CE_______ Resistance _______

Component Condition Good Bad Nature of Defect if Bad _______

TRANSISTOR #3

EB-Forward Resistance _______
EB-Reverse Resistance _______
CB-Forward Resistance _______
CB-Reverse Resistance _______
CE-_______ Resistance _______

Component Condition Good Bad Nature of Defect if Bad _______

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TEST SEMICONDUCTOR DIODES AND BIPOLAR JUNCTION TRANSISTOR, TO IDENTIFY DEFECTS

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #11

Competency: Test Semiconductor Diodes and Bipolar Junction Transistors, to Identify Defects.

Performance Objective: Demonstrate the ability to test semiconductor diodes and bipolar junction transistor, to identify defects according to departmental standards, achieving 100% mastery on the performance exam.

1) Maximum time for the exam is 1 hour.

2) This exam consists of three tasks:

   a. General Knowledge of Semiconductors
   b. Testing Semiconductor Diodes
   c. Testing Bipolar Junction Transistors

3) Documentation of ratings should be made on individual competency exam rating sheet and transferred to the student's competency profile.

4) Examiner must initial the worksheet at the completion of each task.

5) When the student notifies you that she/he has read their instructions, you will record the starting time.

6) For each task, rate the student performance as satisfactory or unsatisfactory on the exam rating sheet. Rating information should be shared with the student upon completion of all parts of the exam.

7) Upon completion of the exam, verify that all testing materials are in your possession.

Equipment/Materials Needed:

1 DMM
3 General purpose diodes
3 Bipolar junction transistors

Time started ________
Time finished ________

COMPETENCY EXAMINATION

SEMICONDUCTOR DIODES AND BIPOLAR JUNCTION TRANSISTOR, TO IDENTIFY DEFECTS

PERFORMANCE EXAM:

TASK 1 ANSWER THE FOLLOWING QUESTIONS TO TEST YOUR GENERAL KNOWLEDGE OF SEMICONDUCTORS: How do you:

1) Identify the cathode end of a diode.

2) Identify the emitter lead of a transistor on a schematic diagram.

3) T F zener diodes can identified just by looking at them.

4) How many resistance measurements must be made to test a transistor?

TASK 2 **TEST EACH DIODE AT THE WORK STATION, INDICATE THE CONDITION OF THE DEVICE AS GOOD OR BAD IN THE SPACE PROVIDED.**

1) Diode #1: Forward Resistance _________ Reverse Resistance _____

Condition of Component Good Bad

If the component checks bad, what type of defect is indicated?

2) Diode #2: Forward Resistance _________ Reverse Resistance _____

Condition of Component Good Bad

If the component checks bad, what type of defect is indicated?

3) Diode #3: Forward Resistance _________ Reverse Resistance ______

If the component checks bad, what type of defect is indicated?

TASK 3 TEST EACH TRANSISTOR AT THE WORK STATION. RECORD THE READINGS IN THE SPACE PROVIDED. INDICATE THE CONDITION OF THE COMPONENT AS GOOD OR BAD. IF THE DEVICE IS DEFECTIVE, INDICATE THE NATURE OF THE DEFECT.

TRANSISTOR #1

EB-Forward Resistance _________
EB-Reverse Resistance _________
CB-Forward Resistance _________
CB-Reverse Resistance _________
CE-_______ Resistance _________

Component Condition Good Bad Nature of Defect if Bad ____

TRANSISTOR #2

EB-Forward Resistance _______
EB-Reverse Resistance _______
CB-Forward Resistance _______
CB-Reverse Resistance _______
CE_______ Resistance _______

Component Condition Good Bad Nature of Defect if Bad ____

TRANSISTOR #3

EB-Forward Resistance _______
EB-Reverse Resistance _______
CB-Forward Resistance _______
CB-Reverse Resistance _______
CE-_______ Resistance _______

Component Condition Good Bad Nature of Defect if Bad ____

COMPETENCY EXAMINATION RATING SHEET

Competency: Test Semiconductor Diodes and Bipolar Junction Transistor, to Identify Defects.

Performance Objective: Demonstrate the ability to test semiconductor diodes and bipolar junction transistor, to identify defects according to departmental standards, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Identified the cathode end of a diode, the emitter lead of a transistor and zener diodes.			
2. Tested semiconductor diodes.			
3. Tested bipolar junction transistors.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TROUBLESHOOTING CASCADED C/E AMPLIFIERS

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #12

Competency: Troubleshoot Cascaded Common Emitter Amplifiers.

Performance Objective: Demonstrate the ability to perform a preliminary trouble shooting of a cascaded C/E amplifiers by analyzing D.C. voltage measurements to departmental standards, achieving 100% mastery on the performance exam.

1) This exam consists of three tasks.

2) You will be rated on your ability to perform each of the three tasks to established departmental standards.

3) The maximum time allowed for this exam is thirty minutes.

4) When instructed by the examiner return the workstation to its pretest conduction.

5) This student exam booklet, any scrap paper, and all equipment must be returned before you are allowed to leave the area. The results of the exam will be discussed at its conclusion.

6) After you have read these instructions, inform the examiner you are ready to begin the exam.

Equipment/Materials Needed:

1 DMM
1 0 to 15 VDC Power Supply
1 Set of Cascaded C/E Amplifiers

Time started: ___________
Time finished: ___________

COMPETENCY EXAMINATION

TROUBLESHOOTING CASCADED C/E AMPLIFIERS

PERFORMANCE EXAM:

TASK 1 Measure the following voltages of Q_1.

A) VC ______________
B) VB ______________
C) VE ______________
D) VCE ______________

Analyze the voltage readings and select one of the following:

A) Cut Off
B) Active Region
C) Saturation Region

TASK 2 Measure the following voltages of Q_2.

A) VC ______________
B) VB ______________
C) VE ______________
D) VCE ______________

Analyze the voltage readings and select one of the following:

A) Cut Off
B) Active Region
C) Saturation Region

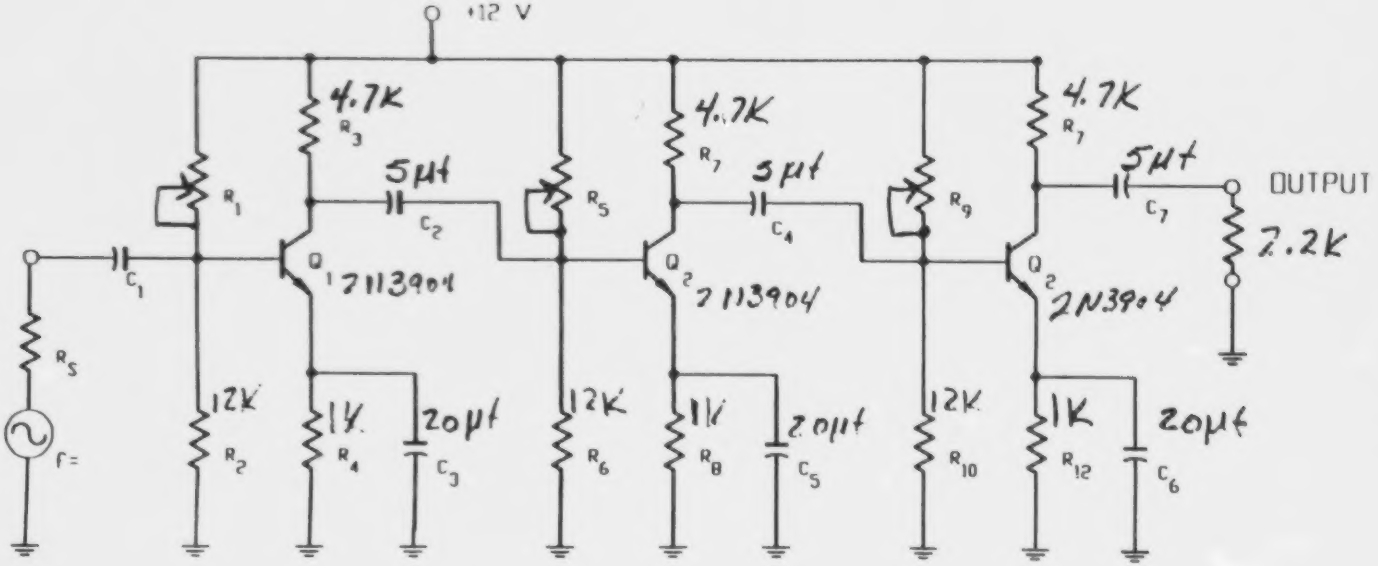
TASK 3 Measure the following voltages of Q_3.

A) VC ______________
B) VB ______________
C) VE ______________
D) VCE ______________

Analyze the voltage readings and select one of the following:

A) Cut Off
B) Active Region
C) Saturation Region

THIS CONCLUDES THIS PERFORMANCE EXAM
RETURN THIS EXAM BOOKLET TO THE INSTRUCTOR


+12 V
4.7K
R3
5μf
C2
R1
C1
Q1 2N3904
RS
f=
12K
R2
1K
R4
20μf
C3
4.7K
R7
5μf
C4
R5
Q2 2N3904
12K
R6
1K
R8
20μf
C5
4.7K
R7
5μf
C7
OUTPUT
2.2K
R9
Q2 2N3904
12K
R10
1K
R12
20μf
C6

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TROUBLESHOOTING CASCADED C/E AMPLIFIERS

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #12

Competency: Troubleshoot Cascaded Common Emitter Amplifiers.

Performance Objective: Demonstrate the ability to perform a preliminary trouble shooting of a cascaded C/E amplifiers by analyzing D.C. voltage measurements to departmental standards, achieving 100% mastery on the performance exam.

1) This exam consists of three tasks.

2) Documentation of ratings should be made on the individual competency exam rating sheet.

3) The maximum time allowed for this exam is thirty minutes.

4) This student exam booklet, any scrap paper, and all equipment must be returned before you are allowed to leave the area. The results of the exam will be discussed at its conclusion.

5) Upon completion of the exam, verify that all testing materials are in your possession.

Equipment/Materials Needed:

1 DMM
1 0 to 15 VDC Power Supply
1 Set of Cascaded C/E Amplifiers

Time started: ___________
Time finished: ___________

COMPETENCY EXAMINATION

TROUBLESHOOTING CASCADED C/E AMPLIFIERS

PERFORMANCE EXAM:

TASK 1 Measure the following voltages of Q_1.

A) VC ____________
B) VB ____________
C) VE ____________
D) VCE ____________

Analyze the voltage readings and select one of the following:

A) Cut Off
B) Active Region
C) Saturation Region

TASK 2 Measure the following voltages of Q_2.

A) VC ____________
B) VB ____________
C) VE ____________
D) VCE ____________

Analyze the voltage readings and select one of the following:

A) Cut Off
B) Active Region
C) Saturation Region

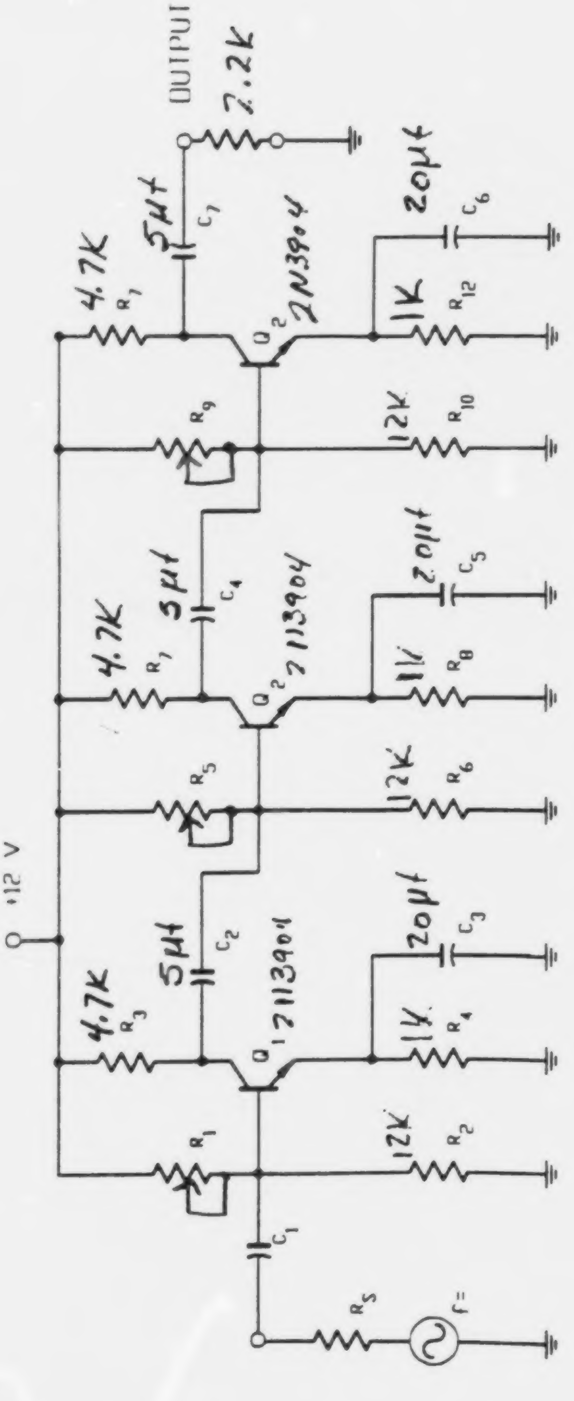
TASK 3 Measure the following voltages of Q_3.

A) VC ____________
B) VB ____________
C) VE ____________
D) VCE ____________

Analyze the voltage readings and select one of the following:

A) Cut Off
B) Active Region
C) Saturation Region

THIS CONCLUDES THIS PERFORMANCE EXAM
RETURN THIS EXAM BOOKLET TO THE INSTRUCTOR

OUTPUT
2.2K
5μf
C7
4.7K
R1
Q2
2N3904
20μf
C6
1K
R12
R9
12K
R10
5μf
C4
4.7K
R7
Q2
2N3904
20μf
C5
1K
R8
R5
12K
R6
+12 V
5μf
C2
4.7K
R3
Q1
2N3904
20μf
C3
1K
R4
R1
12K
R2
C1
RS
f=

COMPETENCY EXAMINATION RATING SHEET

Competency: Troubleshooting Cascaded C/E Amplifiers.

Performance Objective: Demonstrate the ability to perform preliminary trouble shooting of a cascaded c/e amplifier by analyzing D. C. voltage measurements to departmental standards, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Identification of a stage operating in the active region.			
2. Identification of a stage operating in the cut off region.			
3. Identification of a stage operating in the saturation region.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TROUBLESHOOTING CASCADED C/E AMPLIFIERS USING THE SIGNAL TRACING METHOD

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #13

Competency: Troubleshooting Cascaded C/E Amplifiers Using the Signal Tracing Method.

Performance Objective: Demonstrate the ability to identify a defective amplifier in a cascaded configuration using the signal tracing method to departmental standards, achieving 100% mastery on the performance exam.

1) This exam consists of one tasks:

2) You will be rated on your ability to identify a defective stage by signal tracing.

3) The maximum time allowed for the exam is 15 minutes.

4) When instructed by the examiner, return the work station to its pretext condition.

5) The student exam booklet, any scrap worksheets, and all equipment must be returned to the examiner before you are allowed to leave the exam area. The results of the exam will be discussed at the conclusion.

6) After you have read these instructions, inform the examiner that you are ready to begin the exam.

Equipment/Materials Needed:

1 DMM
1 0 to 15 VDC power supply
1 Dual trace oscilloscope
1 Audio signal generator
1 Set of cascaded c/E amplifiers

Time started: _________
Time finished: _________

COMPETENCY EXAMINATION

TROUBLESHOOTING CASCADED C/E AMPLIFIERS USING THE SIGNAL TRACING METHOD

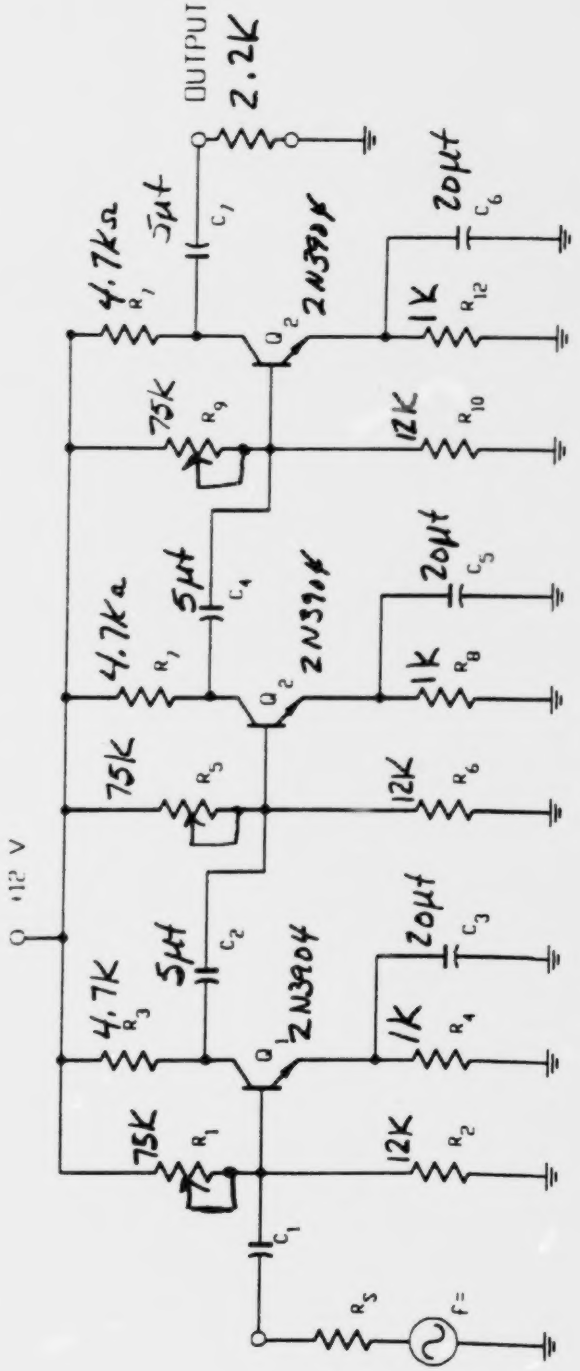
PERFORMANCE EXAM:

TASK 1 Set your audio signal generator for a 1 KHZ, 10mV P/P output and connect the output to C_1. on the schematic diagram.

Using established procedures use the oscilloscope to identify the defective stage.

Defective Stage Q1 Q2 Q3

This completes this performance test. Inform the examiner so that your finish time can be recorded.


OUTPUT
2.2K
4.7kΩ
R1
5µf
C7
2N3904
Q2
20µf
C6
1K
R12
75K
R9
12K
R10
4.7kΩ
R7
5µf
C4
2N3904
Q2
20µf
C5
1K
R8
75K
R5
12K
R6
+12 V
4.7K
R3
5µf
C2
2N3904
Q1
20µf
C3
1K
R4
75K
R1
12K
R2
C1
RS
f=

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

TROUBLESHOOTING CASCADED C/E AMPLIFIERS USING THE SIGNAL TRACING METHOD

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #13

Competency: Troubleshooting Cascaded C/E Amplifiers Using the Signal Tracing Method.

Performance Objective: Demonstrate the ability to identify a defective amplifier in a cascaded configuration using the signal tracing method to departmental standards, achieving 100% mastery on the performance exam.

1) This exam consists of one tasks:

2) Documentation of ratings should be made on individual competency exam rating sheet.

3) The maximum time allowed for the exam is 15 minutes.

4) When instructed by the examiner, return the work station to its pretest condition.

5) This student exam booklet, any scrap paper, and all equipment must be returned before you are allowed to leave the area. The results of the exam will be discussed at its conclusion.

6) Upon completion of the exam verify that all testing materials are in your possession.

Equipment/Materials Needed:

1 DMM
1 0 to 15 VDC power supply
1 Set of cascaded C/E amplifiers

Time started ________
Time finished _______

COMPETENCY EXAMINATION

TROUBLESHOOTING CASCADED C/E AMPLIFIERS USING THE SIGNAL TRACING METHOD

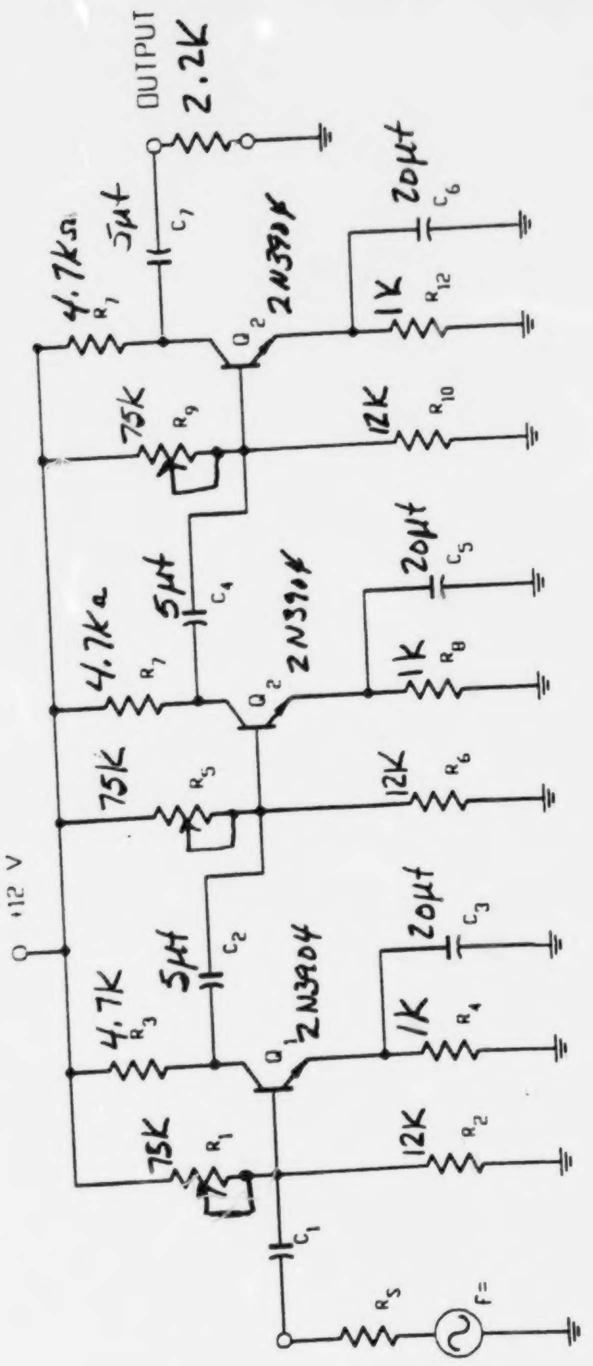
PERFORMANCE EXAM:

TASK 1 Set your audio signal generator for a 1 KHZ, 10mV P/P output and connect the output to C_1. on the schematic diagram.

Using established procedures use the oscilloscope to identify the defective stage.

Defective Stage Q1 Q2 Q3

This completes this performance test. Inform the examiner so that your finish time can be recorded.


OUTPUT
2.2K
4.7KΩ
R1
5μf
C7
20μf
C6
2N3904
Q2
1K
R12
75K
R9
12K
R10
4.7KΩ
R7
5μf
C4
20μf
C5
2N3904
Q2
1K
R8
75K
R5
12K
R6
+12 V
4.7K
R3
5μf
C2
20μf
C3
2N3904
Q1
1K
R4
75K
R1
12K
R2
C1
RS
F=

COMPETENCY EXAMINATION RATING SHEET

Competency: Troubleshooting Cascaded C/E Amplifiers Using the Signal Tracing Method.

Performance Objective: Demonstrate the ability to identify a defective amplifier in a cascaded configuration using the signal tracing method to departmental standards, achieving 100% mastery on the performance exam.

STUDENT ______________________ Competency Mastered YES ____ NO ____

EXAMINER ______________________ Date of Rating ______________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Identified defective amplifier using signal tracing.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CALIBRATION AND OPERATION OF A TEMPERATURE BRIDGE

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #14

Competency: Calibration and Operation of a Temperature Bridge.

Performance Objective: Demonstrate the ability to calibrate and perform an operation/check of a temperature bridge to performance standards, achieving 100% mastery on the performance exam.

1) This exam consists of one task.

2) You will be rated on your ability to perform this job according to departmental standards and the specification sheet accompanying this exam.

3) The maximum time allowed for this exam is one hour.

4) When instructed by the examiner, return the workstation to its pretest conduction.

5) This student exam booklet, any scrap paper, and all equipment must be returned before you are allowed to leave the area.

6) After you have read these instructions, inform the examiner you are ready to begin the exam.

Equipment/Materials Needed:

1 DMM
1 Thermometer
1 ± 12VDC Power Supply
1 Variable D. C. Power Supply
1 Temperature Bridge and Associated Circuitry
Specification sheet for the temperature bridget circuit

Time started: ___________
Time finished: ___________

SPECIFICATION SHEET FOR THE TEMPERATURE BRIDGE

1. All resistors are = ± 2% tolerance.
2. 1 K Ω Thermistor.
3. Temperature compensated operational amplifier.
4. The bridge circuit is to be calibrated at room temperature.

COMPETENCY EXAMINATION

CALIBRATION AND OPERATION OF A TEMPERATURE BRIDGE

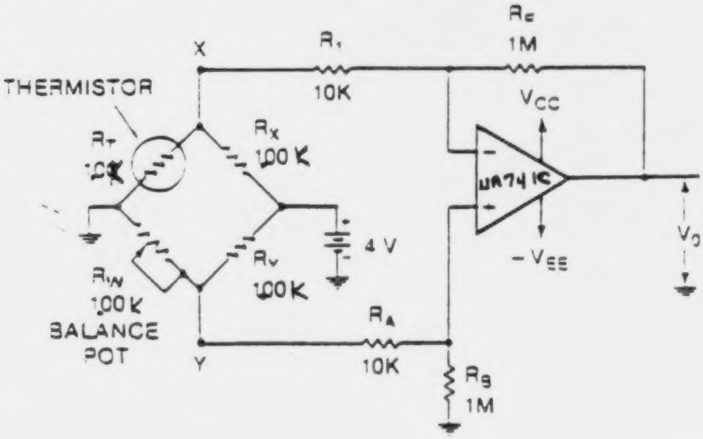
PERFORMANCE EXAM:

TASK 1 Check the calibration and operation of a temperature bridge circuit.

1. Measure Vout of the opamp. Vout ________
2. If the output is not 0VDC Go To Step 3. If the output is normal proceed to step 4.
3. Adjust RW until a 0VDC is obtained.
4. Apply heat to the thermistor and observe the output of the opamp. Does the output go in a positive direction. yes no If the voltage does not change, replace the opamp and repeat step 4. If the voltage does change, let the bridge cool and observe that the opamp output returns to0VDC. This completes the calibration procedure.

This Concludes The Performance Exam

8-14 **Difference amplifier connected to thermistor bridge.**


X
R1
10K
RF
1M
THERMISTOR
RT
10K
RX
100 K
VCC
µA741C
4 V
- VEE
V0
RW
100 K
BALANCE
POT
RY
100K
RA
10K
Y
RB
1M

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CALIBRATION AND OPERATION OF A TEMPERATURE BRIDGE

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #14

Competency: Calibration and Operation of a Temperature Bridge.

Performance Objective: Demonstrate the ability to calibrate and perform an operational check of a temperature bridge to departmental standards, achieving 100% mastery on the performance exam.

1) This performance exam consists of one task.

2) Documentation of ratings should be made on the individual competency exam rating sheet.

3) The maximum time for this exam is one hour.

4) When the student notifies you that he/she has read their instructions, you will record the start time.

5) Upon completion of the exam, verify that all testing materials are in your possession.

Materials Needed:

1 DMM
1 Thermometer
1 ±12 VDC power supply
1 Variable D.C. power supply
1 Temperature bridge and associated circuitry
Specification sheet for the temperature bridge circuit.

Time started: ___________
Time finished: ___________

SPECIFICATION SHEET FOR THE TEMPERATURE BRIDGE

1. All resistors are = ± 2% tolerance.
2. 1 K Ω Thermistor.
3. Temperature compensated operational amplifier.
4. The bridge circuit is to be calibrated at room temperature.

COMPETENCY EXAMINATION

CALIBRATION AND OPERATION OF A TEMPERATURE BRIDGE

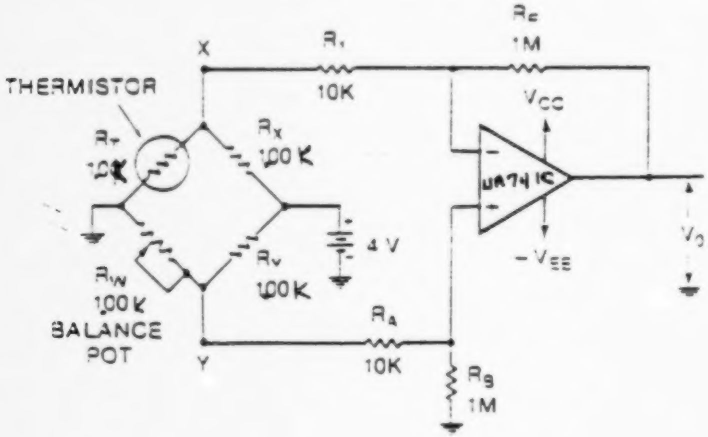
PERFORMANCE EXAM:

TASK 1 Check the calibration and operation of a temperature bridge circuit.

1. Measure Vout of the opamp. Vout ________.
2. If the output is not 0VDC Go To Step 3. If the output is normal proceed to step 4.
3. Adjust RW until a 0VDC is obtained.
4. Apply heat to the thermistor and observe the output of the opamp. Does the output go in a positive direction. yes or no. If the voltage does not change, replace the opamp and repeat step 4. If the voltage does change, let the bridge cool and observe that the opamp output returns to 0VDC. This completes the calibration procedure.

This Concludes The Performance Exam.

8-14 Difference amplifier connected to thermistor bridge.


X
R1
10K
RF
1M
THERMISTOR
RT
100K
RX
100K
VCC
μA741C
−
+
4 V
−VEE
VO
RW
100K
BALANCE
POT
RY
100K
RA
10K
Y
RB
1M

COMPETENCY EXAMINATION RATING SHEET

Competency: Calibration and Operation of a Temperature Bridge.

Performance Objective: Demonstrate the ability to calibrate and perform an operational check of temperature bridge to departmental standards, achieving 100% mastery on the performance exam.

STUDENT ______________________ Competency Mastered YES ____ NO ____

EXAMINER ______________________ Date of Rating ______________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Demonstrated ability to calibrate the temperature bridge.			
2. Demonstrated the ability to perform an operational check of the circuit.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CALIBRATION AND OPERATIONAL CHECK OF AN INSTRUMENTATION SUMMING AMPLIFIER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #15

Competency: Calibration and Operational Check of an Instrumentation Summing Amplifier.

Performance Objective: Demonstrate the ability to calibrate and perform an operational check of an instrumentation summing amplifier to departmental standards, achieving 100% mastery on the performance exam.

1) This exam consists of one task.

2) You will be rated on your ability to perform this job according to departmental standards and the specifications accompanying this exam.

3) The maximum time for this exam is one hour.

4) When instructed by the examiner, return the workstation to its pretest condition.

5) The student exam booklet, any scrape paper, and all equipment must be returned before you are allowed to leave the area.

6) After you have read these instructions, inform the examiner that you are ready to began the exam.

Equipment/Materials Required:

1 3 1/2 Digit DMM
1 ± 12 VDC Power Supply
1 Variable Power Supply 0-15VDC.
Summing amplifier and specification sheet

Time started: ___________
Time finished: ___________

SPECIFICATIONS FOR THE SUMMING AMPLIFIER

1. All resistors are ±1% tolerance.
2. Power supply voltages ±12VDC.
3. Vout measured with 10MΩ input Z DMM and ±10mVS of calculated values.
4. Opamp UA741C or equivalent.

COMPETENCY EXAMINATION

CALIBRATION AND OPERATIONAL CHECK OF AN INSTRUMENTATION SUMMING AMPLIFIER

PEROFRMANCE EXAM:

TASK 1 Check the calibration of the summing amplifier in Fig. 1.

1. Measure and record the values of the following resistors. Each should measure within ± 1% of normal value.

	WITHIN	TOLERANCE
RF ______	YES	NO
R1 ______	YES	NO
R2 ______	YES	NO
R3 ______	YES	NO
R4 ______	YES	NO

If the resistance values check good, perform the procedures in Step 2.

2. Apply 1VDC to each input V1 thru V4. Use a 3 1/2 digit DMM to verify proper output.

V1 IN ______ VOUT _____
V2 IN ______ VOUT _____
V3 IN ______ VOUT _____
V4 IN ______ VOUT _____

If correct vout cannot be obtained, check power supply ± voltage. If the power supply is normal, replace the opamp and red step two. If vout is good, the unit is calibrated. This concludes the performance exam.

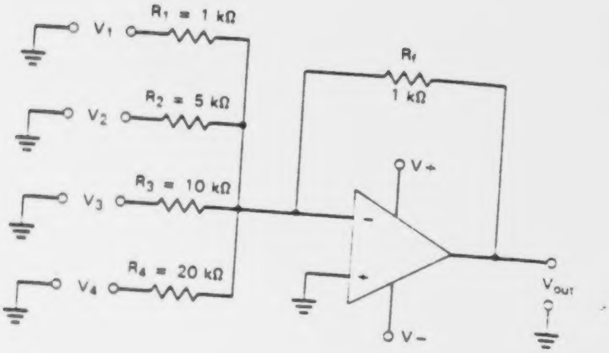

V₁
R₁ = 1 kΩ
V₂
R₂ = 5 kΩ
V₃
R₃ = 10 kΩ
V₄
R₄ = 20 kΩ
Rf
1 kΩ
V+
V−
−
+
Vout

Fig. 1

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

CALIBRATION AND OPERATIONAL CHECK OF AN INSTRUMENTATION SUMMING AMPLIFIER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #15

Competency: Calibration and Operational Check on an Instrumentation Summing Amplifier

Performance Objective: Demonstrate the ability to calibrate and perform an operational check of an instrumentation summing amplifier to departmental standards, achieving 100% mastery on the performance exam.

1) This exam consists of one task.

2) Documentation of ratings should be made on the individual competency exam rating sheet.

3) The maximum time allowed for this exam is one hour.

4) The student exam booklet, scrap paper and all equipment must be accounted for before the student is allowed to leave the area.

5) When the student notifies you that he/she has read their instruction, you will record the starting time.

6) Upon completion of the exam, verify that all testing materials are in your possession.

Equipment/Materials Required:

1 3 1/2 Digit DMIN
1 ± 12 VDC Power Supply
1 Variable Power Supply 0-15VDC.
Summing amplifier and specification sheet

Time started: ___________
Time finished: ___________

SPECIFICATIONS FOR THE SUMMING AMPLIFIER

1. All resistors are ±1% tolerance.
2. Power supply voltages ±12VDC.
3. Vout measured with 10MΩ input Ƶ DMM and ±10mVS of calculated values.
4. Opamp UA741C or equivalent.

COMPETENCY EXAMINATION

CALIBRATION AND OPERATIONAL CHECK OF AN INSTRUMENTATION SUMMING AMPLIFIER

PEROFRMANCE EXAM:

TASK 1 Check the calibration of the summing amplifier in Fig. 1.

1. Measure and record the values of the following resistors. Each should measure within ± 1% of normal value.

WITHIN TOLERANCE

RF _______ YES NO
R1 _______ YES NO
R2 _______ YES NO
R3 _______ YES NO
R4 _______ YES NO

If the resistance values check good, perform the procedures in Step 2.

2. Apply 1VDC to each input V1 thru V4. Use a 3 1/2 digit DMM to verify proper output.

V1 IN ______ VOUT _____
V2 IN ______ VOUT _____
V3 IN ______ VOUT _____
V4 IN ______ VOUT _____

If correct vout cannot be obtained, check power supply ± voltage. If the power supply is normal, replace the opamp and red step two. If vout is good, the unit is calibrated. This concludes the performance exam.

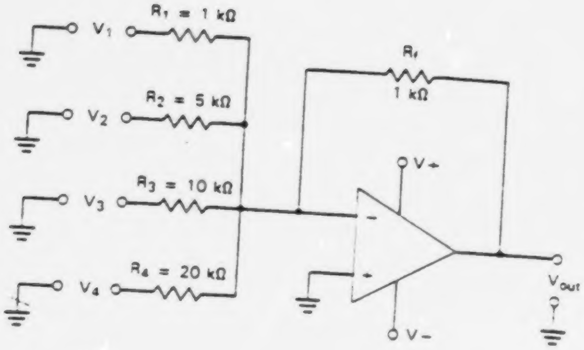

R_1 = 1 kΩ
V_1
R_2 = 5 kΩ
V_2
R_3 = 10 kΩ
V_3
R_4 = 20 kΩ
V_4
R_f
1 kΩ
V+
−
+
V−
V_{out}

Fig. 1

COMPETENCY EXAMINATION RATING SHEET

Competency: Calibration and Operational Check of an Instrumentation Summing Amplifier

Performance Objective: Demonstrate the ability to calibrate and perform a operational check of an instrumentation summing amplifier to departmental standards, achieving 100% mastery on the performance exam.

STUDENT ______________________ Competency Mastered YES ____ NO ____

EXAMINER ______________________ Date of Rating ______________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Demonstrated ability to verify proper operation of the summing amplifier.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

PERFORM ALIGNMENT OF AN A.M. SUPERHETROCYNE RECEIVER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #16

Competency: Perform Alignment of an A.M. Superhetrodyne Receiver

Performance Objective: Given the proper materials, equipment and service manual the student will demonstrate the ability to perform a complete alignment of an A. M. superhetrodyne receiver using manufactures specifications, achieving 100% mastery on the performance exam.

1) This exam consists of one tasks.

2) You will be rated on your ability to perform to manufactures specifications in the service manual.

3) The maximum time allowed for this exam is one hour.

4) When instructed by the examiner, return the workstation to its pretest conduction.

5) This student exam booklet, any scrap paper, and all equipment must be returned before you are allowed to leave the area.

6) After you have read these instructions, inform the examiner you are ready to begin the exam.

Equipment/Materials Needed:

1 Dual Trace Oscilloscope
1 R. F. Signal Generator Capable Of Supplying Modulated R. F.
1 Audio Signal Generator
1 Frequency Counter
1 Service Manual
1 Set Non-Inductive Turning Tools

Time started: ___________
Time finished: ___________

COMPETENCY EXAMINATION

PERFORM ALIGNMENT OF AN A.M. SUPERHETROCYNE RECEIVER

PERFORMANCE EXAM:

TASK 1 Using the service manual provided perform a complete alignment of the A.M. superhetrodyne receiver at the work station.

1) Alignment of I.F. strip

2) Tuning of mixer circuit for proper output.

3) Tracking of local oscillator and R.F. Amplifier.

[redacted]

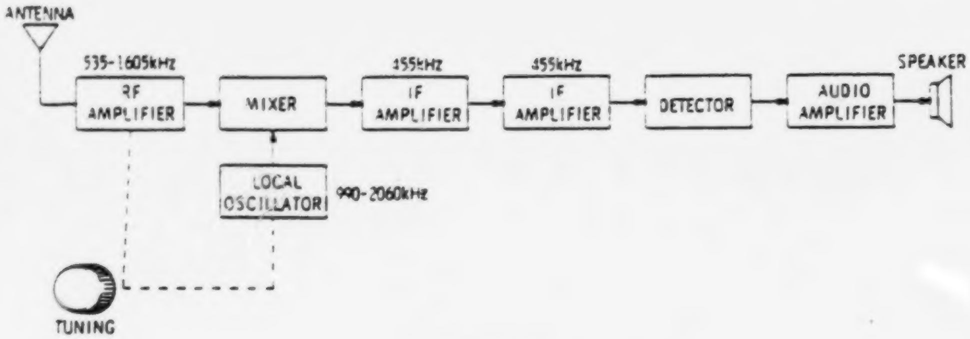

ANTENNA
535-1605kHz
RF AMPLIFIER
MIXER
455kHz
IF AMPLIFIER
455kHz
IF AMPLIFIER
DETECTOR
AUDIO AMPLIFIER
SPEAKER
LOCAL OSCILLATOR
990-2060kHz
TUNING

Figure 3-9
Standard AM broadcast superheterodyne receiver.

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

PERFORM ALIGNMENT OF AN A. M. SUPERHETRODYNE RECEIVER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #16

Competency: Perform Alignment of an A.M. Superhetrodyne Receiver.

Performance Objective: Given the proper materials, equipment and service manual the student will demonstrate the ability to perform a complete alignment of an A. M. superhetrodyne receiver using manufactures specifications, achieving 100% mastery on the performance exam.

1) This performance exam consists of one task.

2) Documentation of ratings should be made on the individual competency exam rating sheet.

3) The maximum time for this exam is one hour.

4) When the student notifies you that he/she has read their instructions, you will record the start time.

5) Upon completion of the exam verify that all testing materials are in your possession.

Equipment/Materials Needed:

1 Dual Trace Oscilloscope
1 R. F. Signal Generator Capable Of Supplying Modulated R. F.
1 Audio Signal Generator
1 Frequency Counter
1 Service Manual
1 Set Non-Inductive Turning Tools

Time started: ___________
Time finished: ___________

COMPETENCY EXAMINATION

PERFORM ALIGNMENT OF AN A. M. SUPERHETRODYNE RECEIVER

PERFORMANCE EXAM:

TASK 1 Using the service manual provided perform a complete alignment of the A.M. superhetrodyne receiver at the work station.

1) Alignment of I.F. strip

2) Tuning of mixer circuit for proper output.

3) Tracking of local oscillator and R.F. Amplifier.

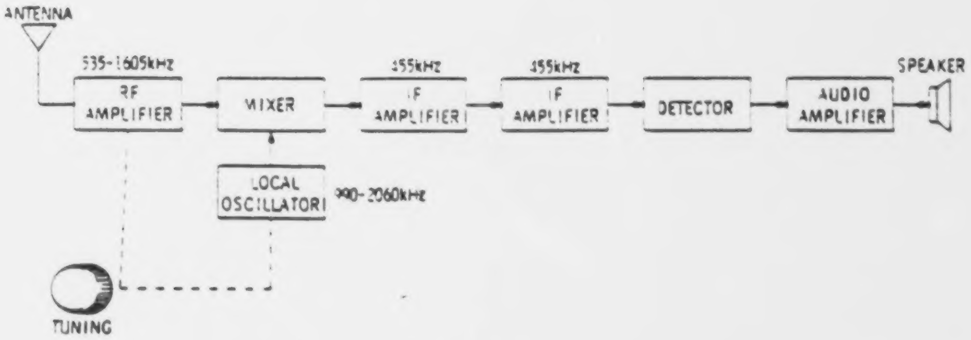

ANTENNA
535-1605kHz
RF AMPLIFIER
MIXER
455kHz
IF AMPLIFIER
455kHz
IF AMPLIFIER
DETECTOR
AUDIO AMPLIFIER
SPEAKER
LOCAL OSCILLATOR
990-2060kHz
TUNING

Figure 3-9
Standard AM broadcast superheterodyne receiver.

COMPETENCY EXAMINATION RATING SHEET

Competency: Perform Alignment of an A.M. Superhetrodyne Receiver.

Performance Objective: Given the proper materials, equipment and service manual the student will demonstrate the ability to perform a complete alignment of an A. M. superhetrodyne receiver using manufactures specifications, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Demonstrated ability to align I.F. amplifiers.			
2. Demonstrated the ability to tune mixer stage to the difference frequency.			
3. Demonstrated the ability to track the local oscillator and R. F. Amplifier.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

RECEIVER TROUBLESHOOTING

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #17

Competency: Receiver Troubleshooting.

Performance Objective: Demonstrate the ability to troubleshoot an A. M. superhetrodyne receiver using signal injection to isolate the detective stage and a DMM and transistor checker to determine the defective component, achieving 100% mastery on the performance exam.

1) This exam consists of two tasks.

2) You will be rated on your ability to perform each tasks to departmental procedures.

3) The maximum time allowed for this exam is one hour and thirty minutes.

4) When instructed by the examiner, return the workstation to its pretest conduction.

5) The student exam booklet, any scrap paper, and all equipment must be returned before you are allowed to leave the area.

6) After you have read these instructions, inform the examiner you are ready to begin the exam.

Equipment/Materials Needed:

1 Dual Trace Oscilloscope
1 R. F. Signal Generator Capable Of Supplying Modulated R. F.
1 Audio Signal Generator
1 Frequency Counter
1 Service Manual for the Specific Receiver.

Time started: ___________
Time finished: ___________

COMPETENCY EXAMINATION

RECEIVER TROUBLESHOOTING

PERFORMANCE EXAM:

TASK 1

A) Check Power Supply (DMM) Good Bad

B) Isolate the defective stage using signal injection. Good Bad

C) Audio Amps Good Bad

D) Detector Good Bad

E) Second I.F.Amp Good Bad

F) First I.F. Amp Good Bad

G) Mixer Stage Good Bad

H) Local Oscillator Good Bad

I) First R. F. Amp Good Bad

TASK 2 Isolate defective stage to a defective component.

A) Measure the following Voltages of the Defective Stage.

The Defective Stage

1) VC- Normal Abnormal

2) VB- Normal Abnormal

3) VE- Normal Abnormal

B) Check transistor with either an in circuit transistor checker or if not available a DMM to verify condition of the transistor.

Good Bad

C) Using Established Procedures use the DMM to locate defective part by making resistance measurements

Defective Part is ____________________

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

RECEIVER TROUBLESHOOTING

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #17

Competency: Receiver Troubleshooting.

Performance Objective: Demonstrate the ability to troubleshoot an A.M. superhetrodyne receiver using signal injection to isolate the defective stage and a DMM and transistor checker to determine the defective component achieving 100% mastery on the performance exam.

1) This performance exam consists of two task.

2) Documentation of ratings should be made on the individual competency exam rating sheet.

3) The maximum time for this exam is one hour and thirty minutes.

4) When the student notifies you that he/she has read their instructions, you will record the start time.

5) Upon completion of the exam verify that all testing materials are in your possession.

Equipment/Materials Needed:

1 Dual Trace Oscilloscope
1 R. F. Signal Generator Capable Of Supplying
  Modulated R. F.
1 Audio Signal Generator
1 Frequency Counter
1 Service Manual for the Specific Receiver.

Time started: ____________
Time finished: ___________

COMPETENCY EXAMINATION

RECEIVER TROUBLESHOOTING

PERFORMANCE EXAM:

TASK 1	A) Check Power Supply (DMM)	Good	Bad
	B) Isolate the defective stage using signal injection.	Good	Bad
	C) Audio Amps	Good	Bad
	D) Detector	Good	Bad
	E) Second I.F.Amp	Good	Bad
	F) First I.F. Amp	Good	Bad
	G) Mixer Stage	Good	Bad
	H) Local Oscillator	Good	Bad
	I) First R. F. Amp	Good	Bad

TASK 2 Isolate defective stage to a defective component.

A) Measure the following Voltages of the Defective Stage.

The Defective Stage

1) VC-	Normal	Abnormal
2) VB-	Normal	Abnormal
3) VE-	Normal	Abnormal

B) Check transistor with either an in circuit transistor checker or if not available a DMM to verify condition of the transistor.

Good Bad

C) Using Established Procedures use the DMM to locate defective part by making resistance measurements

Defective Part is ____________________

COMPETENCY EXAMINATION RATING SHEET

Competency: Receiver Troubleshooting.

Performance Objective: Demonstrate the ability to troubleshoot an A. M. superhetrodyne receiver using signal injection to isolate the detective stage and a DMM and transistor checker to determine the defective component, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Demonstrated the ability to isolate the defective stage.			
2. Demonstrated the ability to determine the defective component.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

VERIFICATION OF CORRECT OPERATION OF A SEVEN-SEGMENT DISPLAY DRIVEN BY A DECODER DRIVER AND A DECADE COUNTER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #18

Competency: Verification of Correct Operation of a Seven-Segment Display Driven by a Decoder Driver and a Decade Driver

Performance Objective: Demonstrate the ability to a minimum performance check of a seven-segment display driven by a decoder driver and a decade counter using the TTL Data Book as a standards, achieving 100% mastery on the performance exam.

1) This exam consists of one task.

2) You will be rated on your ability to perform a minimum performance check of the circuit included with this exam.

3) The maximum time for this exam is one hour.

4) When instructed by the examiner, return the workstation to its pretest condition.

5) The student exam booklet, any scrape paper, and all equipment must be returned before you are allowed to leave the area.

6) After you have read these instructions, inform the examiner that you are ready to began the exam.

Equipment/Materials Required:

1 Dual trace oscilloscope
1 DMM 3 1/2 Digit 10 MΩ input Z
1 Digital Logic Probe
1 Logic Pulser or TTL Clock Generator
1 TTL Data Book

Time started: ___________
Time finished: ___________

COMPETENCY EXAMINATION

VERIFICATION OF CORRECT OPERATION OF A SEVEN-SEGMENT DISPLAY DRIVEN BY A DECODER DRIVER AND A DECADE DRIVER

PERFORMANCE EXAM:

TASK 1 Verify that all sections of the display driver circuit are working correctly.

A) Seven-Segment Display Status.
1) defective
EXAMINER INIT 2) checks ok

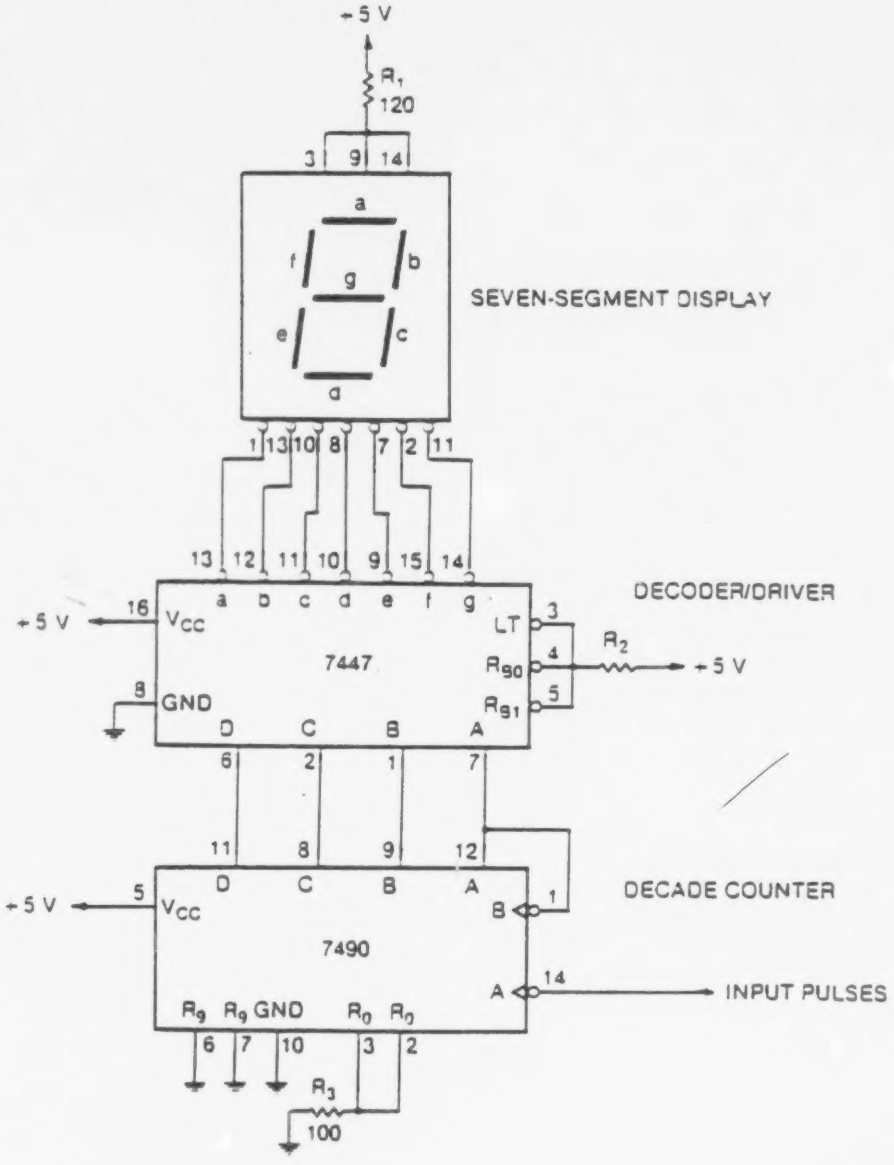
B) Decoder Driver Status.
1) Output Lines a-g normal/abnormal.
EXAMINER INIT 2) Lines A-D select correct output lines.

C) Decade Counter Status.
EXAMINER INIT 1) Provides correct count. Yes No

D) After all sections have been checked, connect a 10HZ TTL signal to the decade counter to verify that all sections will function as a unit.

10-27 **Connecting a seven-segment display to a counter with a 7447 decoder/driver.**

(A) Circuit


+5 V
R1
120
3
9
14
a
b
c
d
e
f
g
SEVEN-SEGMENT DISPLAY
1
13
10
8
7
2
11
13
12
11
10
9
15
14
DECODER/DRIVER
+5 V
16
VCC
GND
8
7447
LT
RBO
RBI
3
4
5
R2
+5 V
D
C
B
A
6
2
1
7
11
8
9
12
DECADE COUNTER
+5 V
5
VCC
7490
B
1
A
14
INPUT PULSES
R9
R9
GND
R0
R0
6
7
10
3
2
R3
100

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

VERIFICATION OF CORRECT OPERATION OF A SEVEN-SEGMENT DISPLAY DRIVEN BY A DECODER DRIVER AND A DECADE COUNTER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #18

Competency: Verification of Correct Operation of Seven-Segment Display Driven by a Decoder Driver and Decade Counter

Performance Objective: Demonstrate the ability to minimum performance check of a seven-segment display driven by decoder-driver and a decade counter using the TTL Data Book as a standard, achieving 100 % mastery on the performance exam.

1) This exam consists of one task.

2) Documentation of ratings should be made on the individual competency exam rating sheet.

3) The maximum time allowed for this exam is one hour.

4) When the student notifies you that he/she has read their instruction, you will record the starting time.

5) Upon completion of the exam, verify that all testing materials are in your possession.

Equipment/Materials Required:

1 Dual trace oscilloscope
1 DMM 3 1/2 Digit 10 MΩ input Z
1 Digital Logic Probe
1 Logic Pulser or TTL Clock Generator
1 TTL Data Book

Time started: ____________
Time finished: ____________

COMPETENCY EXAMINATION

VERIFICATION OF CORRECT OPERATION OF A SEVEN-SEGMENT DISPLAY DRIVEN BY A DECODER DRIVER AND A DECADE DRIVER

PERFORMANCE EXAM:

TASK 1 Verify that all sections of the display driver circuit are working correctly.

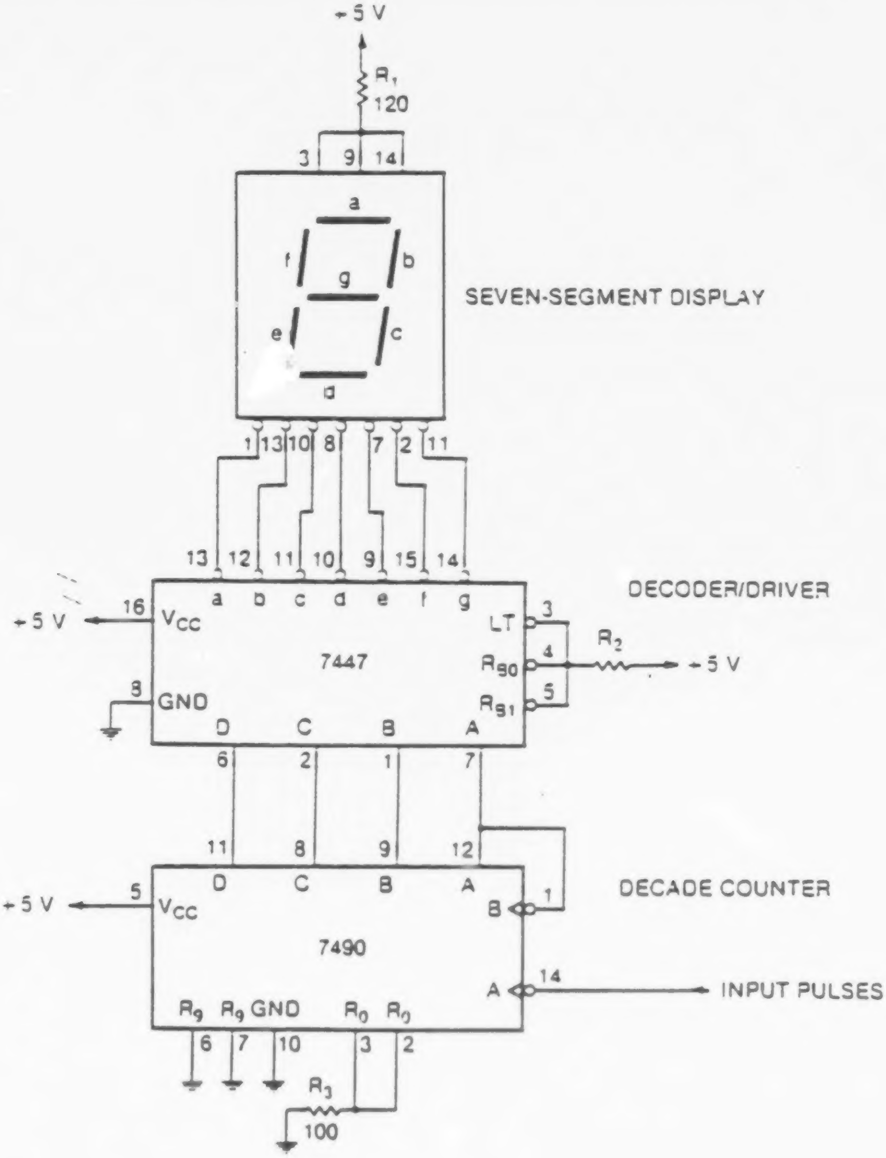
A) Seven-Segment Display Status.
1) defective
EXAMINER INIT 2) checks ok

B) Decoder Driver Status.
1) Output Lines a-g normal/abnormal.
EXAMINER INIT 2) Lines A-D select correct output lines.

C) Decade Counter Status.
EXAMINER INIT 1) Provides correct count. Yes No

D) After all sections have been checked, connect a 10HZ TTL signal to the decade counter to verify that all sections will function as a unit.

10-27 Connecting a seven-segment display to a counter with a 7447 decoder/driver.


+5 V
R1
120
3
9
14
a
f
b
g
e
c
d
SEVEN-SEGMENT DISPLAY
1 13 10 8 7 2 11
13 12 11 10 9 15 14
a b c d e f g
DECODER/DRIVER
+5 V
16
VCC
7447
LT
3
R2
RBO
4
+5 V
RBI
5
8
GND
D C B A
6 2 1 7
11 8 9 12
D C B A
DECADE COUNTER
+5 V
5
VCC
B
1
7490
A
14
INPUT PULSES
R9 R9 GND R0 R0
6 7 10 3 2
R3
100

(A) Circuit

COMPETENCY EXAMINATION RATING SHEET

Competency: Verification of Correct Operation of Seven-Segment Display Driven by a Decoder Driver and Decade Counter

Performance Objective: Demonstrate the ability to a minimum performance check of a seven-segment display driven by a decoder driver and a decade counter using the TTL Data Book as a standards, achieving 100% mastery on the performance exam.

STUDENT ____________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________ Date of Rating ____________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Able to verify correct operation of the seven segment display.			
2. Able to briefly correct operation of the decoder driver.			
3. Able to verify correct operation of the decade counter.			
4. Verify that all sections function as a single unit.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

PERFORM MINIMUM PERFORMANCE CHECK OF AN EIGHT TRACE LOGIC ANALYZER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #19

Competency:	Perform Minimum Performance Check of an Eight Trace Logic Analyzer.
Performance Objective:	Given the proper material and equipment the student will demonstrate the ability to perform a minimum performance check of an eight trace logic analyzer and adjust or repair as necessary, achieving 100% mastery on the performance exam.

1) This exam consists of one task.

2) You will be rated on your ability to perform to this exam according to the specification sheet accompanying this test. You may use the TTL Data Book to verify correct wiring and pin out information.

3) The maximum time allowed for this exam is one hour.

4) When instructed by the examiner return the workstation to its pretest conduction.

5) This student exam booklet, any scrap paper, and all equipment must be returned before you are allowed to leave the area.

6) After you have read these instructions, inform the examiner you are ready to begin the exam.

Equipment/Materials Needed:

1 DMM
1 Dual Trace Oscilloscope
1 Logic Pulser or TTl Clock Generator
1 Logic Probe
1 The Circuit in Figure 3 Previously Constructed on Suitable Breadboard
1 5 Volt Power Supply
1 Frequency Counter
1 TTL Data Book

Time started: ___________
Time finished: ___________

PRELIMINARY SETTINGS

PERFORM MINIMUM PERFORMANCE CHECK OF AN EIGHT TRACE LOGIC ANALYZER

PERFORMANCE EXAM:

TASK 1 Using the following values as preliminary settings for this exam.

A) R_1 set to 224 OHMS

B) R_2 set to 370 OHMS

C) R_4 set 8K OHMS

D) R_5 set to 6.2K OHMS

NOTE: Adjustment to these values may be required as the performance exam progresses. Do not change them unless they fall to meet the specifications listed on the minimum performance section.

SPECIFICATIONS FOR THE LOGIC ANALYZER

A) Clock Generator - the clock generator is designed to operate at 1MHZ±.ZMHZ. Adjustment of R1 and R2 in Figure 2 may be required to obtain the specified output.

B) The output of the staircase generator shall be eight separate steps as shown in Figure 1.

C) The input to the 74151 MUX unit can be any 8 bits of information that requires analysis with respect to time. This unit is particularly useful for analyzing counter circuits. Two 7493 IC's can be used for the eight data inputs.

D) Use the following settings for preliminary settings for the performance exam.

A) R1 Fig. 2 to 220 Ω
B) R2 Fig. 2 to 370 Ω
C) R4 Fig. 3 to 8 K Ω
D) R5 Fig. 3 to 6.2 K Ω

COMPETENCY EXAMINATION

PERFORM MINIMUM PERFORMANCE CHECK OF AN EIGHT TRACE LOGIC ANALYZER

PERFORMANCE EXAM:

TASK 1 Perform minimum performance check as listed in the specification sheet that accompanies this exam.

A) Clock generator frequency check:

Measure and record the output ______.

1) If within limits go to step two. If not adjust or repair as necessary.

2) Use the oscilloscope to observe the staircase generator output. If normal proceed to the Mux check section, otherwise troubleshoot and repair to obtain correct output. R4 and R5 should be adjusted to obtain proper symmetry.

3) Multiplexer check - check each line of the 74151 MUX IC to verify proper operation. If the IC fails this check, the IC should be replaced.

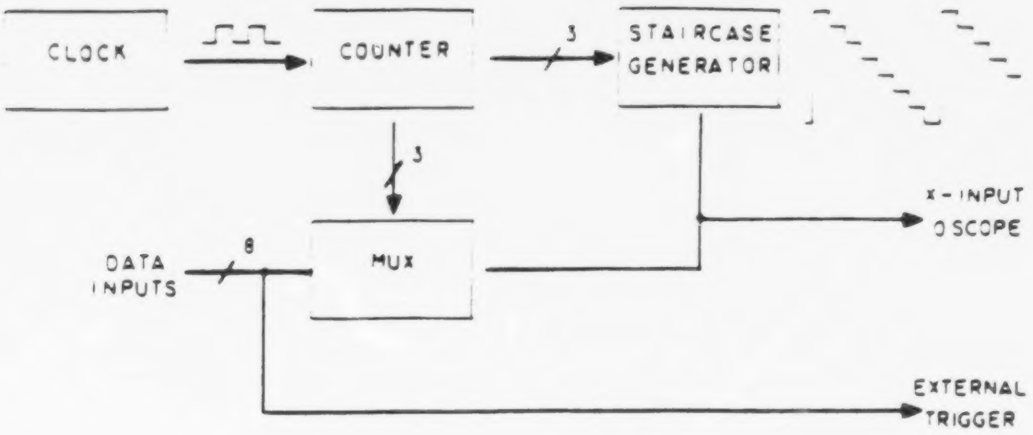

CLOCK
COUNTER
3
STAIRCASE GENERATOR
3
DATA INPUTS
8
MUX
X-INPUT O SCOPE
EXTERNAL TRIGGER

Figure 1

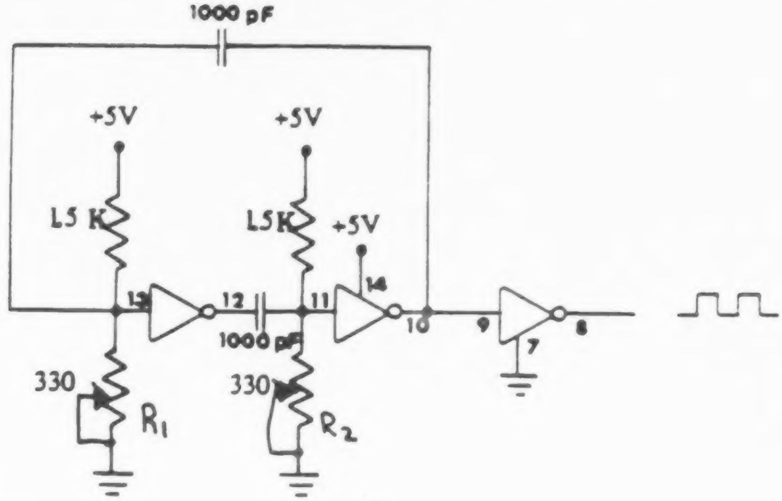

1000 pF
+5V
+5V
1.5 K
1.5K
+5V
14
13
12
11
10
9
8
7
1000 pF
330
R1
330
R2

Figure 2

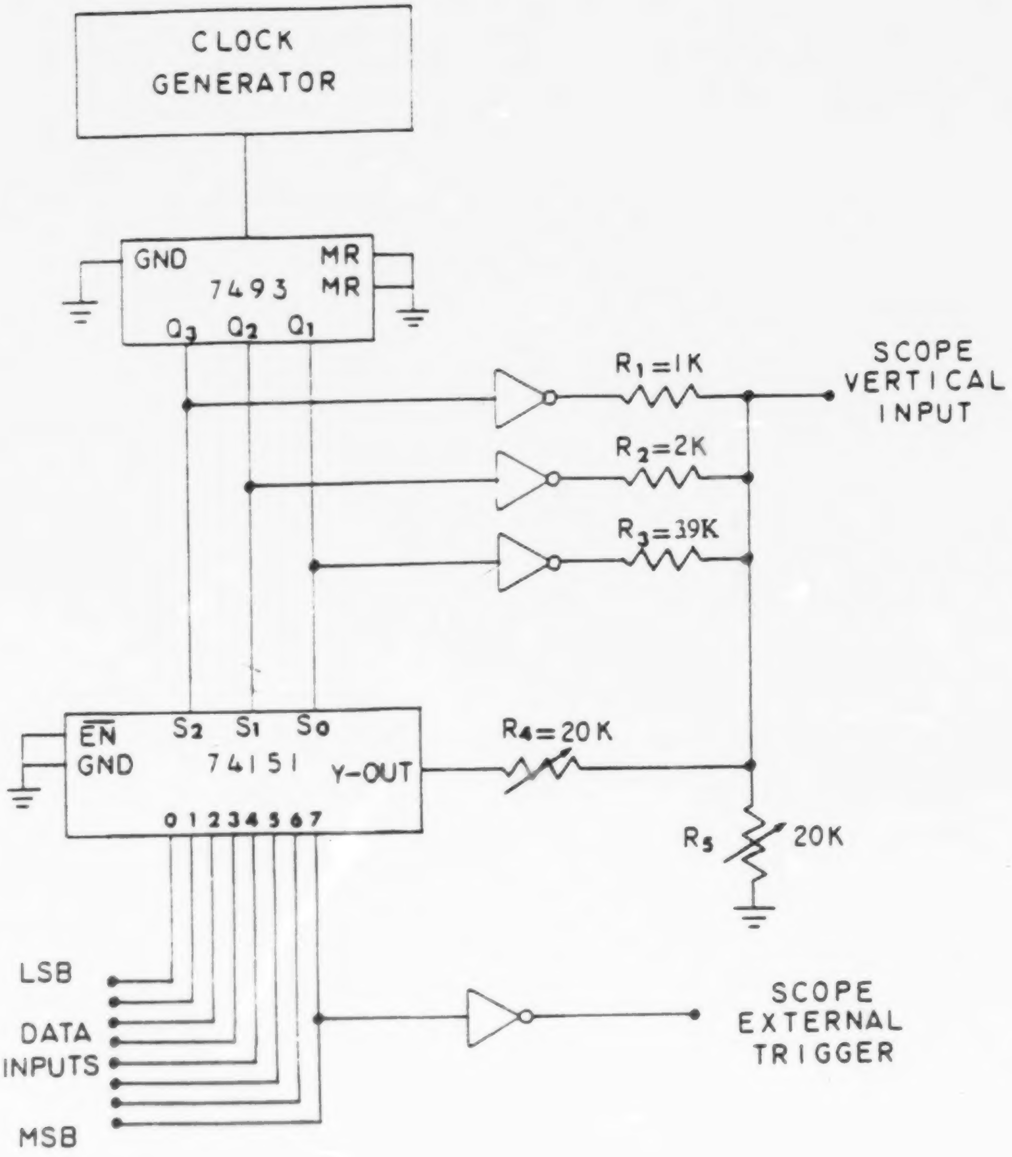

CLOCK GENERATOR
GND
7493
MR
MR
Q3
Q2
Q1
R1=1K
R2=2K
R3=39K
SCOPE VERTICAL INPUT
EN
GND
S2
S1
S0
74151
Y-OUT
0 1 2 3 4 5 6 7
R4=20K
R5
20K
LSB
DATA INPUTS
MSB
SCOPE EXTERNAL TRIGGER

Figure 3

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

PERFORM MINIMUM PERFORMANCE CHECK OF AN EIGHT TRACE LOGIC ANALYZER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #19

Competency:	Perform Minimum Performance Check of an Eight Trace Logic Analyzer.
Performance Objective:	Given the proper materials, and equipment the student will demonstrate the ability to perform a minimum performance check of an eight trace logic analyzer and adjust or repair as necessary, achieving 100% mastery on the performance exam.

1) This exam consists of one task.

2) Documentation of ratings should be made on the individual competency exam rating sheet.

3) The maximum time for this exam is one hour.

4) When the student notifies you that he/she has read their instructions, you will record the start time.

5) Upon completion of the exam verify that all testing materials are in your possession.

Equipment/Materials Needed:

1 DMM
1 Dual Trace Oscilloscope
1 Logic Pulser or TTL Clock Generator
1 Logic Probe
1 The Circuit in Figure 3 Previously Constructed on Suitable Breadboard
1 5 Volt D. C. Power Supply
1 Frequency Counter
1 TTL Data Book

Time started: ___________
Time finished: ___________

PRELIMINARY SETTINGS

PERFORM MINIMUM PERFORMANCE CHECK OF AN EIGHT TRACE LOGIC ANALYZER

PERFORMANCE EXAM:

TASK 1 Using the following values as preliminary settings for this exam.

A) R_1 set to 224 OHMS

B) R_2 set to 370 OHMS

C) R_4 set 8K OHMS

D) R_5 set to 6.2K OHMS

NOTE: Adjustment to these values may be required as the performance exam progresses. Do not change them unless they fall to meet the specifications listed on the minimum performance section.

SPECIFICATIONS FOR THE LOGIC ANALYZER

A) Clock Generator - the clock generator is designed to operate at 1MHZ±.1MHZ. Adjustment of R1 and R2 in Figure 2 may be required to obtain the specified output.

B) The output of the staircase generator shall be eight separate steps as shown in Figure 1.

C) The input to the 74151 MUX unit can be any 8 bits of information that requires analysis with respect to time. This unit is particularly useful for analyzing counter circuits. Two 7493 IC's can be used for the eight data inputs.

D) Use the following settings for preliminary settings for the performance exam.

A) R1 Fig. 2 to 220 Ω
B) R2 Fig. 2 to 370 Ω
C) R4 Fig. 3 to 8 K Ω
D) R5 Fig. 3 to 6.2 K Ω

COMPETENCY EXAMINATION

PERFORM MINIMUM PERFORMANCE CHECK OF AN EIGHT TRACE LOGIC ANALYZER

PERFORMANCE EXAM:

TASK 1 Perform minimum performance check as listed in the specification sheet that accompanies this exam.

A) Clock generator frequency check:

Measure and Record the output ______

1) If within limits go to step two. If not adjust or repair as necessary.

2) Use the oscilloscope to observe the staircase generator output. If normal proceed to the Mux check section otherwise troubleshoot and repair to obtain correct output. R4 and R5 should be adjusted to obtain proper symmetry.

3) Multiplexer check - check each line of the 74151 MUX IC to verify proper operation. If the IC fails this check, the IC should be replaced.

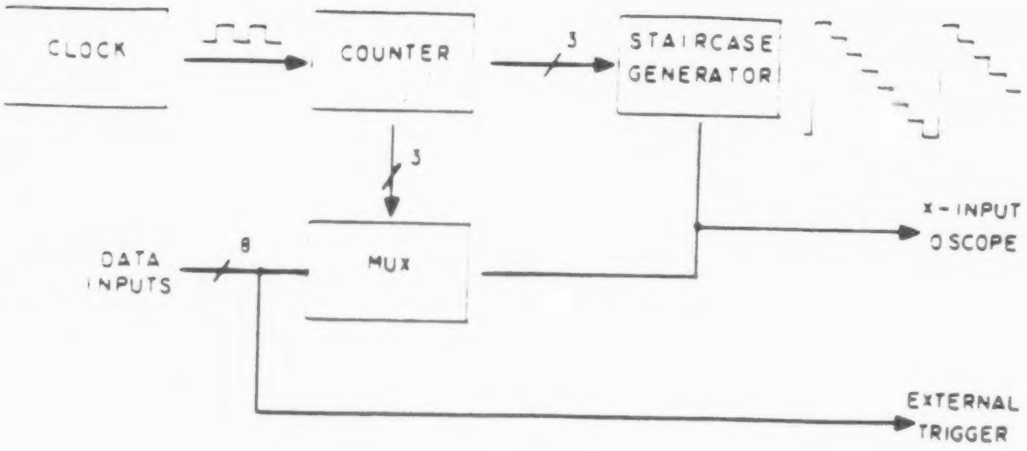

CLOCK
COUNTER
3
STAIRCASE GENERATOR
3
MUX
DATA INPUTS
8
x - INPUT O SCOPE
EXTERNAL TRIGGER

Figure [illegible] -1

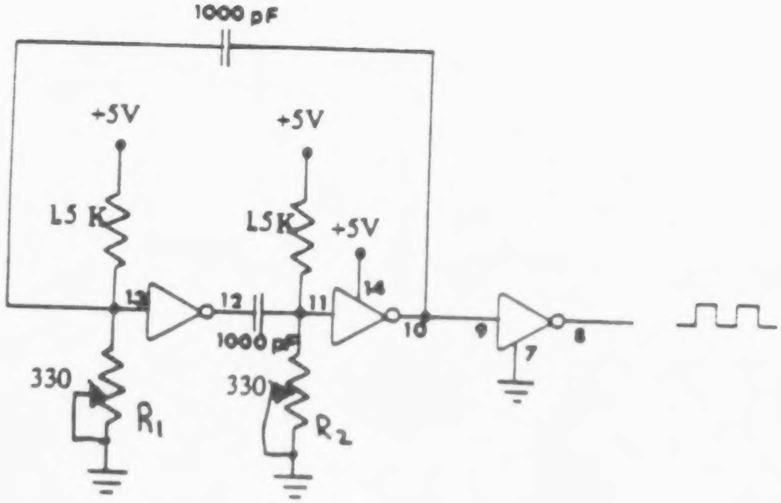

1000 pF
+5V
+5V
1.5 K
1.5K
+5V
13
12
11
14
10
9
8
7
1000 pF
330
R₁
330
R₂

Figure 2

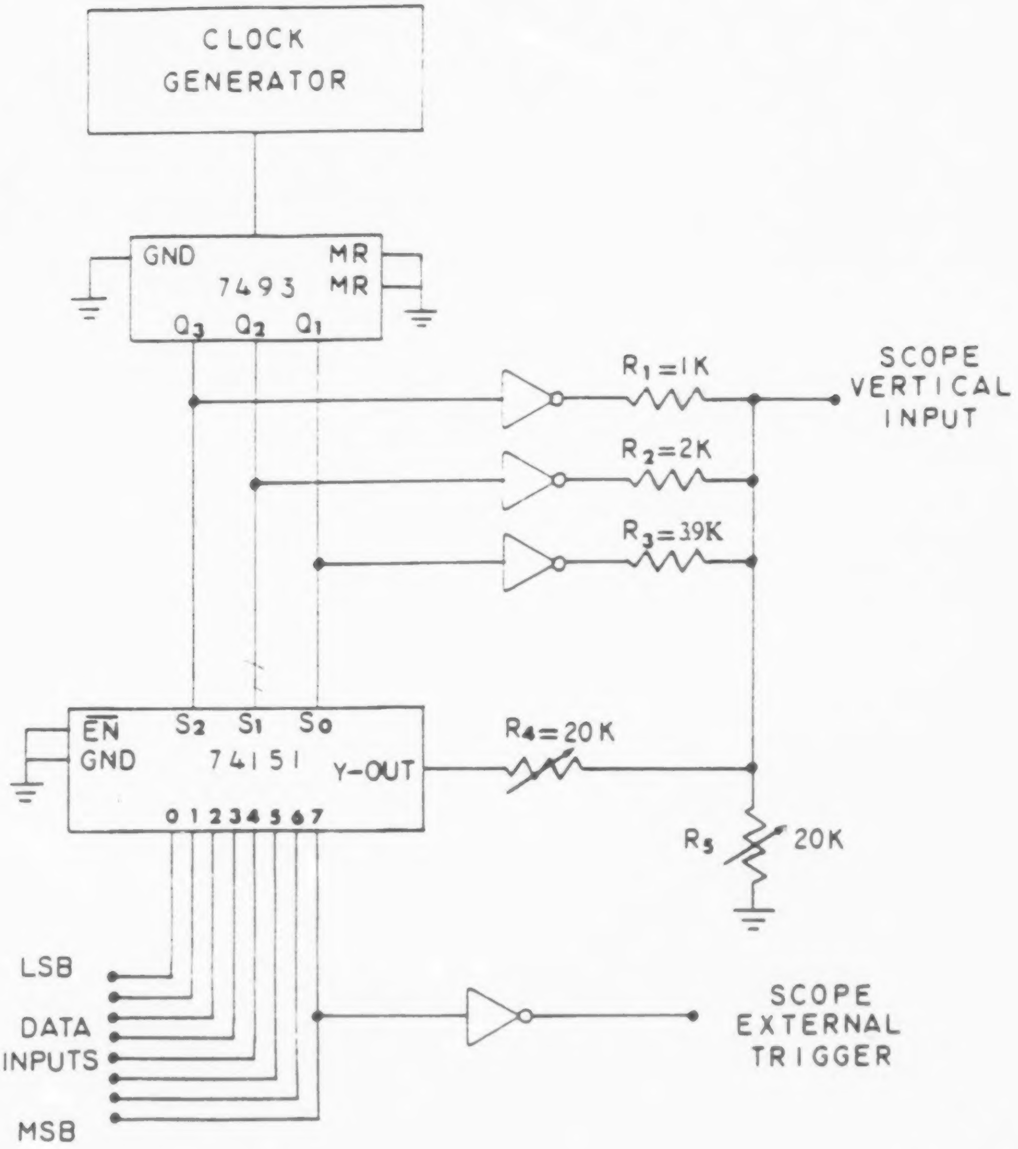

CLOCK GENERATOR
GND
MR
7493
MR
Q_3
Q_2
Q_1
$R_1=1K$
SCOPE VERTICAL INPUT
$R_2=2K$
$R_3=39K$
$\overline{EN}$
GND
S_2
S_1
S_0
74151
Y-OUT
$R_4=20K$
0 1 2 3 4 5 6 7
R_5
20K
LSB
DATA INPUTS
MSB
SCOPE EXTERNAL TRIGGER

Figure 3

COMPETENCY EXAMINATION RATING SHEET

Competency: Perform Minimum Performance Check of an Eight Trace Logic Analyzer.

Performance Objective: Given the proper materials and equipment the student will demonstrate the ability to perform minimum performance check of an eight trace logic analyzer and adjust or repair as necessary, achieving 100% mastery on the performance exam.

STUDENT ______________________________ Competency Mastered YES ____ NO ____

EXAMINER ____________________________ Date of Rating ______________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Demonstrated ability to perform the minimum performance check and repair and adjust the logic analyzer to the specification listed on the specification sheet.			

Comments:

STUDENT MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

VERIFY PROPER OPERATION OF A FREQUENCY COUNTER

ELECTRONICS/INSTRUMENTATIONOCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE STUDENT

PERFORMANCE EXAMINATION #20

Competency: Verify Proper Operation of a Frequency Counter.

Performance Objective: Demonstrate the ability to perform a minimum performance check of a frequency counter including troubleshooting adjustment of repair to departmental specifications, achieving 100% mastery on the performance exam.

1) This exam consists of one tasks.

2) You will be rated on your ability to perform the tasks to established departmental standards.

3) The maximum time allowed for this exam is one hour.

4) When instructed by the examiner, return the workstation to its pretest conduction.

5) The student exam booklet, any scrap paper, and all equipment must be returned before you are allowed to leave the area. The results of the exam will be discussed at its conclusion.

6) After you have read these instructions, inform the examiner you are ready to begin the exam.

Equipment/Materials Needed:

1 DMM
1 5VDC power supply
1 Dual trace oscilloscope
Theory of operation
Block diagram
Troubleshooting flowchart
1 Digital Logic Probe
1 Digital Pulser or TTL clock Gen
Frequency counter circuit Figure 11-19
1 TTL Data Book

Time started: ___________
Time finished: ___________

COMPETENCY EXAMINATION

VERIFY PROPER OPERATION OF A FREQUENCY COUNTER

PERFORMANCE EXAM:

TASK 1 Using the theory of operation, block diagram, and troubleshooting flowchart, perform a minimum performance check of the frequency counter. Adjust, troubleshoot and repair the circuit as necessary to meet minimum standards. A TTL Data Book is available to aid you in this job.

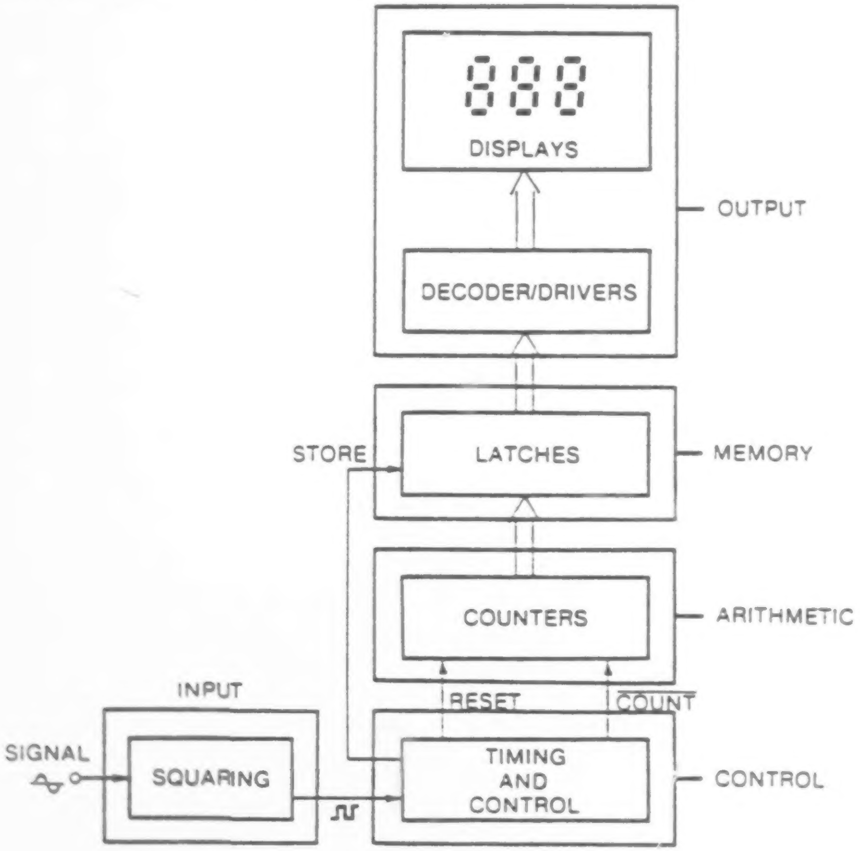
Briefly, here's how the counter operates. The input signal, whose frequency is to be measured, is fed to the squaring block. The squaring circuit essentially amplifies the input signal and forms it into a rectangular wave, which is TTL compatible. Before the start of a measuring period, the timing and control circuitry generates a RESET pulse, then it permits the squared input signal to pass through a gate for exactly 1 s. The output signal from the gate is a series of $\overline{\text{COUNT}}$ pulses, at the same frequency as the original input signal.

The $\overline{\text{COUNT}}$ pulses are fed to decade counters, which total up the number of cycles of the input wave that occur in 1 s. At the end of the 1-s period, the count gate is disabled, preventing any more pulses from getting through. Then a STORE pulse is generated by the control circuitry. It causes the outputs of the counters to be stored in the latches. Latches are essentially *D* flip-flops, which are used as temporary memory locations. They hold the previous count while the counters are being updated.

The latch outputs feed decoder/driver chips, which are connected to seven-segment displays. The numbers read on the displays represent the number of cycles per second (hertz) of the incoming signal.

Fig. 11-19 shows a detailed chip-level diagram of the frequency counter. The timing diagram is shown in Fig. 11-20. The clock (IC-3) is a 555 timer chip used as an astable multivibrator. The output at pin 3 is a rectangular wave whose positive interval is calibrated to exactly 1 s by adjusting pot R_1.

11-18 Block diagram of frequency counter.



The falling edge of the CLOCK signal triggers a one shot in IC-4, causing pin 13 to go high for a short-duration pulse. The pulse width, which is controlled by R_1–C_2, is approximately 100 µs long. This pulse, called STORE, is fed to the enable inputs of the 7475 latches and causes the data on the D inputs of the latches to be stored at the Q outputs.

The falling edge of the STORE pulse triggers a 1-s shot in the 74122 package. The second monostable generates the RESET pulse, which is fed to all counters. Thus, the counters are cleared prior to the next counting period.

Notice that the $\overline{\text{COUNT}}$ waveform in Fig. 11-20 consists of a series of pulses at the frequency of the input signal. Since the gate (IC-2) is enabled for exactly 1 s, the number of pulses fed to the 7490 decade counters is equal to the frequency of the input signal. The input frequency must be less than 1000 Hz for this system.

Now let's discuss how to troubleshoot the frequency counter of Fig. 11-19. You start by feeding a signal into the input jack. Let's say the signal is at a frequency of a few hundred hertz. By observing the seven-segment display, you can tell quite a bit about any possible problems. For example, if the least significant digit appears to work properly but the second and third digits do not light or do not change when the input signal frequency is changed, you know that all of the input and timing and control circuitry must be working. Also IC-7, IC-10, and IC-13 must be working. So, the place to look for the problem is from IC-6 on.

Now suppose that none of the displays are working normally. Where do you begin to test? One good method is to split the system in half, say by looking at the outputs of the arithmetic circuits. Do this by clipping a logic monitor over IC-7. Then, if the outputs are *not* normal, split the first half of the system again, possibly by looking at the inputs to the counters, then at the clock, and so on. If the outputs of the counters are normal, split the second half of the systems by looking at the outputs of the latches. Then look at the outputs of the decoder/drivers, etc.

Fig. 11-21 is a flowchart indicating possible tests to make on the frequency counter of Fig. 11-19. The procedure assumes that an input signal is applied, and either no outputs or abnormal outputs are observed in the displays. Study the flowchart to see how it works. Try to imagine a specific fault and see if the flowchart leads you to it. Obviously, no detailed test procedure is 100% foolproof. There will always be some problems that cannot be solved in any general procedure. The flowchart should stimulate you to think about how to zero in on a defective area with the least amount of unnecessary effort.

As mentioned, you can clip a logic monitor, like the LM-1, over each chip that you wish to test and see if its outputs are normal. However, if the outputs are changing periodically, or if you wish to look at the outputs and inputs of several chips simultaneously, a more useful test instrument is the LM-3 triggerable logic monitor, shown in Fig. 11-22.

The LM-3 can simultaneously monitor up to 40 channels, or test points, which are connected to the instrument through a ribbon cable. Tiny clips at the end of each input wire allow you to clip on to any point in the system. A front panel toggle switch allows you to select the logic high input level as TTL/DTL, CMOS, or variable, which is controlled by a threshold control pot.

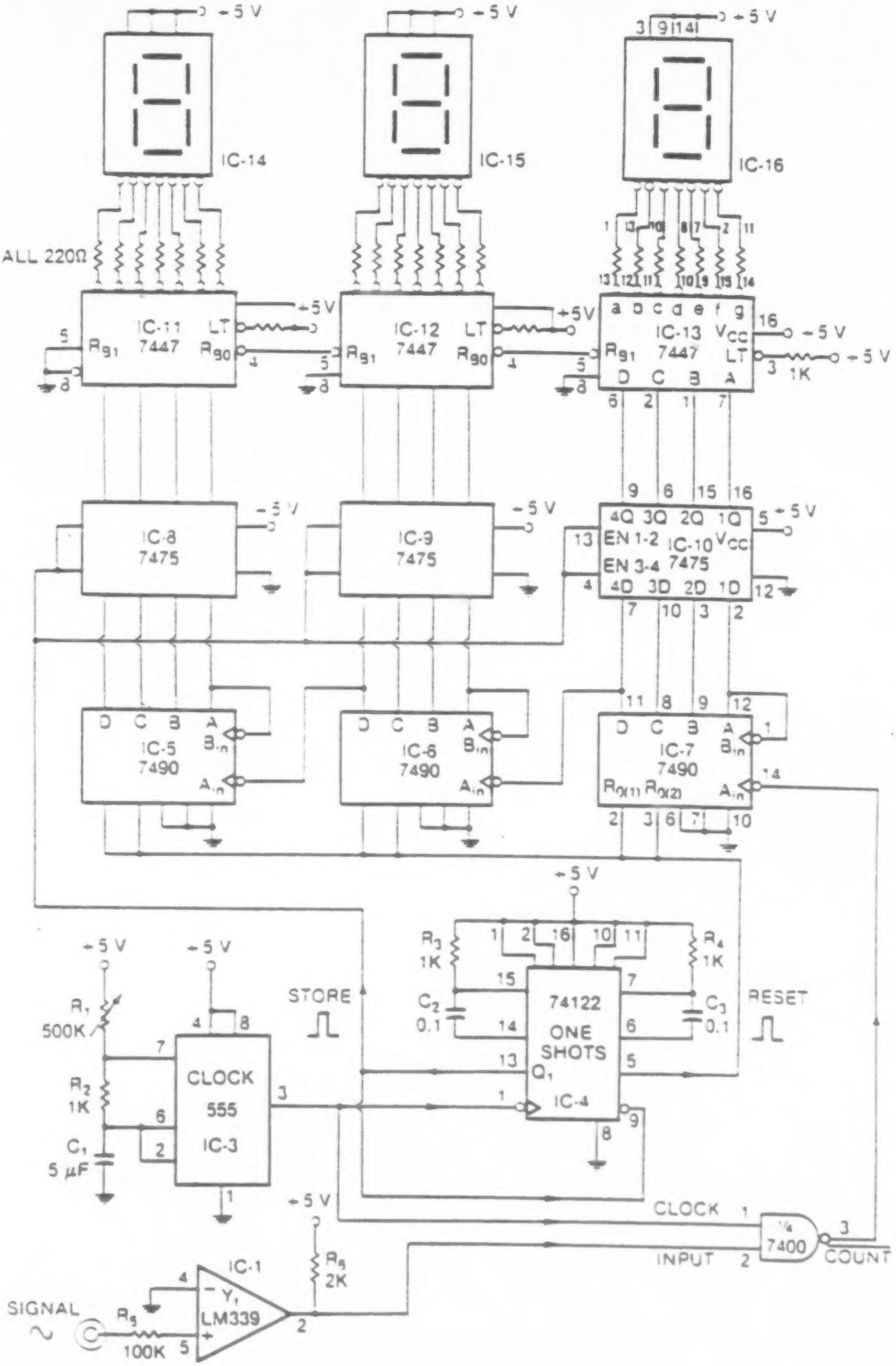
One powerful feature of the LM-3 is that the data displayed on the 40 LED are *latched* into the display by the transition if a trigger signal from high to low or from low to high. For example, if you connected input clips to all 7490 outputs and then used the STORE signal (pin 5 of IC-4) as the trigger, you would latch and display all of the counter outputs at the time of the positive transition of STORE. This would allow you to compare the counter outputs to the numerals displayed on the seven-segment readouts.

In addition, you could also latch in the outputs of the 7475 chips, 7447 chips, clock, reset, or any combination of these. It is also possible to use the LM-3 in the run mode, which means that input data are not latched. This allows you to observe up to 40 points in the system simultaneously and see what each point is doing in real time. This is particularly useful when testing systems in which major events are occurring slowly enough to be observed by a human but where many points must be monitored simultaneously. The LM-3 collects all test point data and displays them on one panel.

As usual, testing specific single points or signals is probably best done with a logic probe or oscilloscope. For example, the short-duration STORE and RESET pulses can be easily seen after being "stretch out" by the logic probe. But $\overline{\text{COUNT}}$ and INPUT are best observed with an oscilloscope.

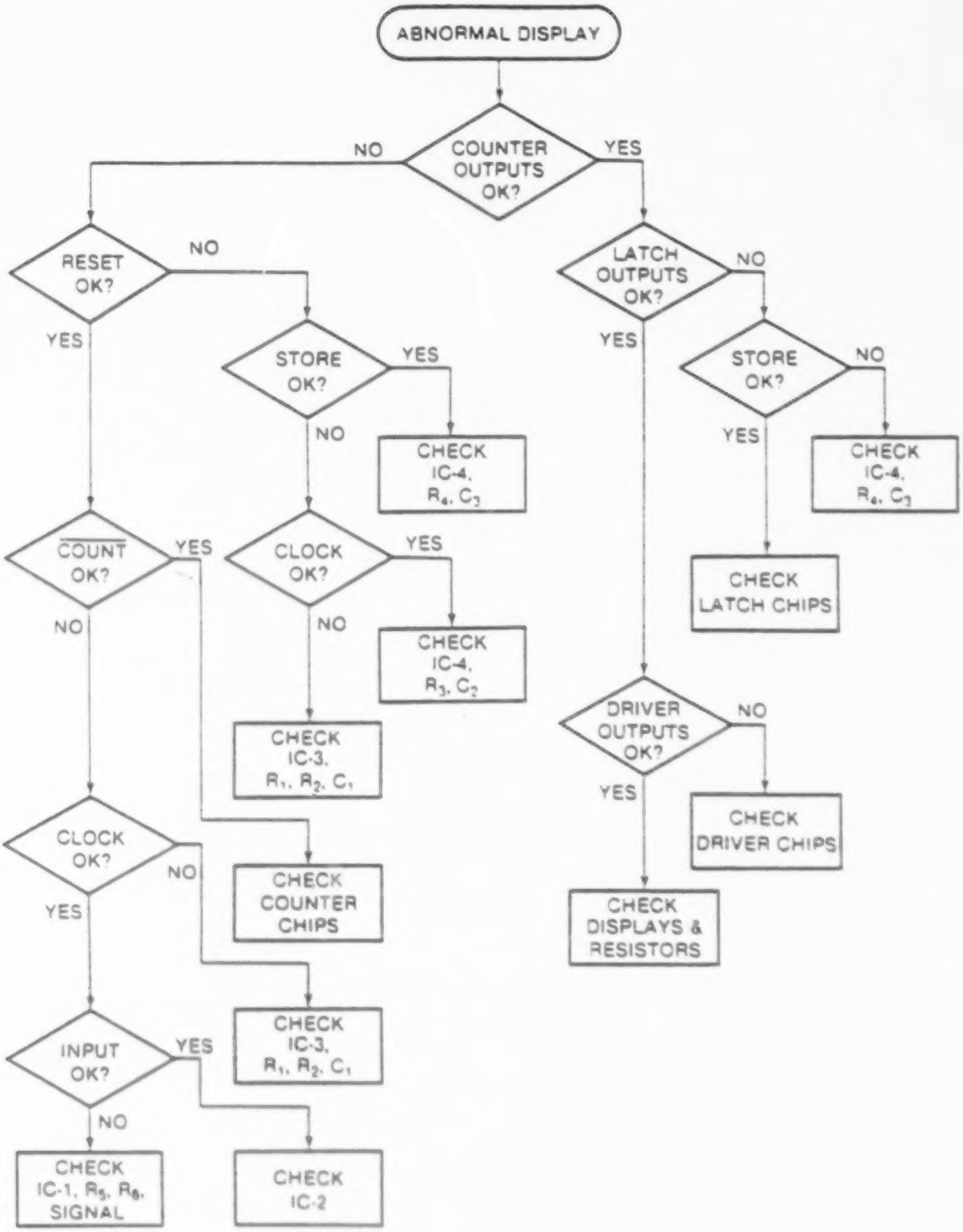
The digital pulser again becomes useful to apply a STORE, RESET, or single $\overline{\text{COUNT}}$ pulse at various points in the system.

11-19 MSI frequency counter.



+5 V
IC-14
IC-15
IC-16
ALL 220Ω
IC-11
7447
LT
R_{B1}
R_{BO}
IC-12
7447
IC-13
7447
a b c d e f g
V_{CC}
1K
D C B A
IC-8
7475
IC-9
7475
4Q 3Q 2Q 1Q
EN 1-2
EN 3-4
IC-10
7475
4D 3D 2D 1D
IC-5
7490
IC-6
7490
IC-7
7490
B_{in}
A_{in}
$R_{0(1)}$ $R_{0(2)}$
74122
ONE SHOTS
IC-4
Q_1
R_3 1K
R_4 1K
C_2 0.1
C_3 0.1
STORE
RESET
R_1 500K
R_2 1K
C_1 5 μF
CLOCK
555
IC-3
CLOCK
INPUT
¼ 7400
COUNT
IC-1
Y_1
LM339
R_5 2K
SIGNAL
R_5
100K

11-21 **Flowchart for troubleshooting the frequency counter of Fig. 11-19.**


ABNORMAL DISPLAY
COUNTER OUTPUTS OK?
NO
YES
RESET OK?
NO
YES
LATCH OUTPUTS OK?
NO
YES
STORE OK?
YES
NO
CHECK IC-4, R_4, C_3
STORE OK?
NO
YES
CHECK IC-4, R_4, C_3
$\overline{\text{COUNT}}$ OK?
YES
NO
CLOCK OK?
YES
NO
CHECK IC-4, R_3, C_2
CHECK LATCH CHIPS
CHECK IC-3, R_1, R_2, C_1
DRIVER OUTPUTS OK?
NO
YES
CHECK DRIVER CHIPS
CLOCK OK?
NO
YES
CHECK COUNTER CHIPS
CHECK DISPLAYS & RESISTORS
CHECK IC-3, R_1, R_2, C_1
INPUT OK?
YES
NO
CHECK IC-1, R_5, R_6, SIGNAL
CHECK IC-2

EXAMINER MANUAL

COMPETENCY EXAMINATION

COMPETENCY:

VERIFY PROPER OPERATION OF A FREQUENCY COUNTER

ELECTRONICS / INSTRUMENTATION OCCUPATIONS

SPECIFIC INSTRUCTIONS FOR THE EXAMINER

PERFORMANCE EXAMINATION #20

Competency: Verify Proper Operation of a Frequency Counter.

Performance Objective: Demonstrate the ability to perform a minimum performance check of a frequency counter including troubleshooting adjustment of repair to departmental specifications, achieving 100% mastery on the performance exam.

1) This exam consists of one tasks.

2) Documentation of ratings should be made on the individual competency exam rating sheet.

3) The maximum time allowed for this exam is one hour.

4) When the student notifies you that he/she has read their instruction, you will record the start time.

5) Upon completion of the exam, verify that all testing materials are in your possession.

Equipment/Materials Needed:

1 DMM
1 5VDC power supply
1 Dual trace oscilloscope
Theory of Operation
Block Diagram
Troubleshooting flowchart
1 Digital Logic Probe
1 Digital Pulser or TTL clock gen
Frequency counter circuit Figure 11-19
1 TTL Data Book

Time started: ___________
Time finished: ___________

COMPETENCY EXAMINATION

VERIFY PROPER OPERATION OF A FREQUENCY COUNTER

PERFORMANCE EXAM:

TASK 1 Using the theory of operation, block diagram, and troubleshooting flowchart, perform a minimum performance check of the frequency counter. Adjust, troubleshoot and repair the circuit as necessary to meet minimum standards. A TTL Data Book is available to aid you in this job.

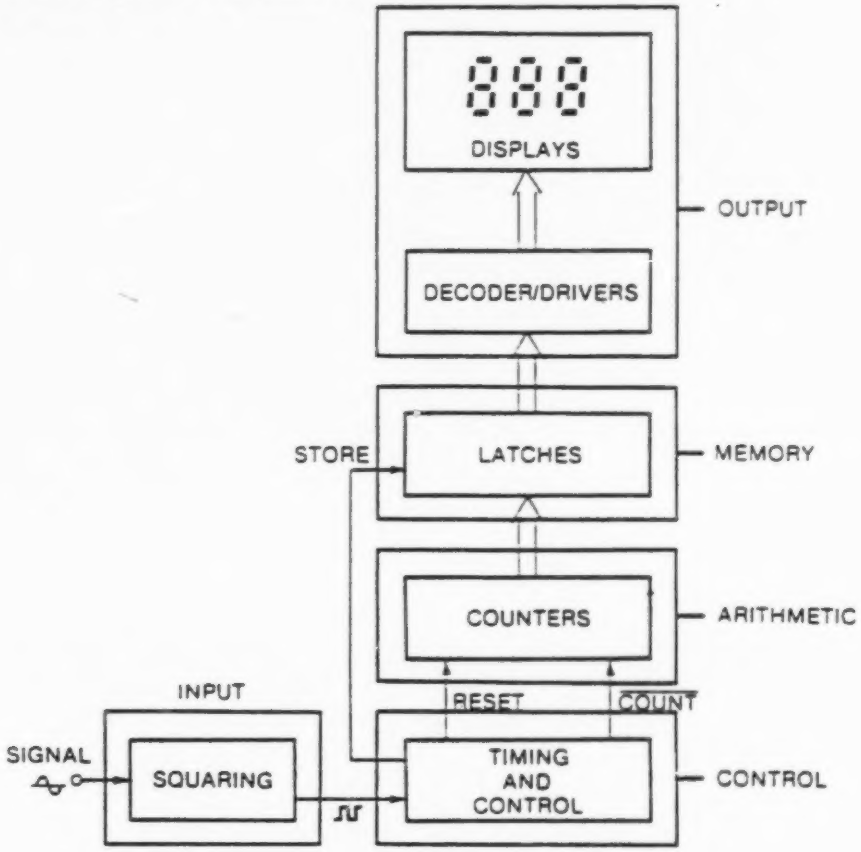
Briefly, here's how the counter operates. The input signal, whose frequency is to be measured, is fed to the squaring block. The squaring circuit essentially amplifies the input signal and forms it into a rectangular wave, which is TTL compatible. Before the start of a measuring period, the timing and control circuitry generates a RESET pulse, then it permits the squared input signal to pass through a gate for exactly 1 s. The output signal from the gate is a series of $\overline{\text{COUNT}}$ pulses, at the same frequency as the original input signal.

The $\overline{\text{COUNT}}$ pulses are fed to decade counters, which total up the number of cycles of the input wave that occur in 1 s. At the end of the 1-s period, the count gate is disabled, preventing any more pulses from getting through. Then a STORE pulse is generated by the control circuitry. It causes the outputs of the counters to be stored in the latches. Latches are essentially *D* flip-flops, which are used as temporary memory locations. They hold the previous count while the counters are being updated.

The latch outputs feed decoder/driver chips, which are connected to seven-segment displays. The numbers read on the displays represent the number of cycles per second (hertz) of the incoming signal.

Fig. 11-19 shows a detailed chip-level diagram of the frequency counter. The timing diagram is shown in Fig. 11-20. The clock (IC-3) is a 555 timer chip used as an astable multivibrator. The output at pin 3 is a rectangular wave whose positive interval is calibrated to exactly 1 s by adjusting pot R_1.

11-18 Block diagram of frequency counter.



The falling edge of the CLOCK signal triggers a one shot in IC-4, causing pin 13 to go high for a short-duration pulse. The pulse width, which is controlled by R_7–C_2, is approximately 100 μs long. This pulse, called STORE, is fed to the enable inputs of the 7475 latches and causes the data on the *D* inputs of the latches to be stored at the *Q* outputs.

The falling edge of the STORE pulse triggers a 1-s shot in the 74122 package. The second monostable generates the RESET pulse, which is fed to all counters. Thus, the counters are cleared prior to the next counting period.

Notice that the $\overline{\text{COUNT}}$ waveform in Fig. 11-20 consists of a series of pulses at the frequency of the input signal. Since the gate (IC-2) is enabled for exactly 1 s, the number of pulses fed to the 7490 decade counters is equal to the frequency of the input signal. The input frequency must be less than 1000 Hz for this system.

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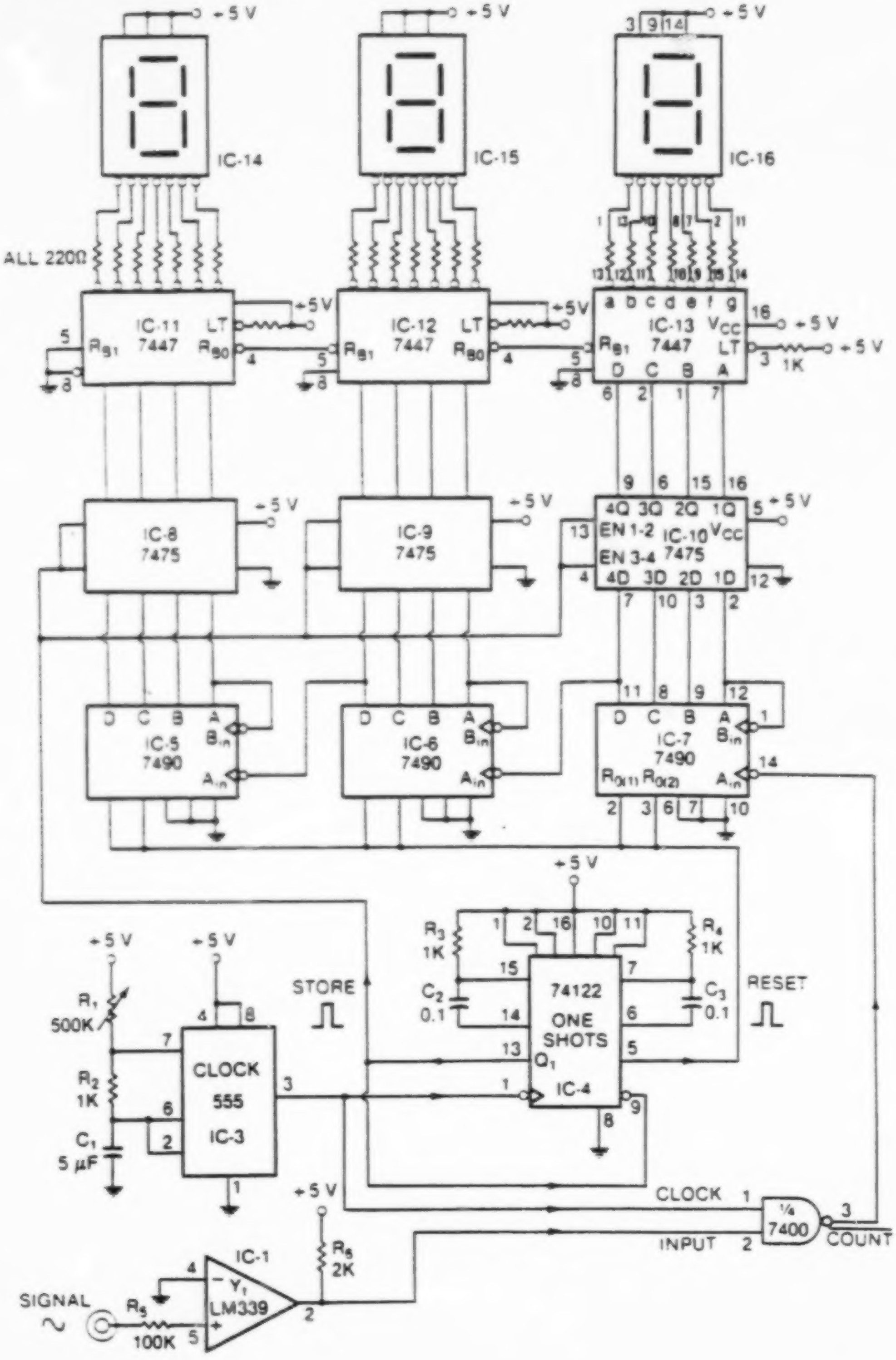
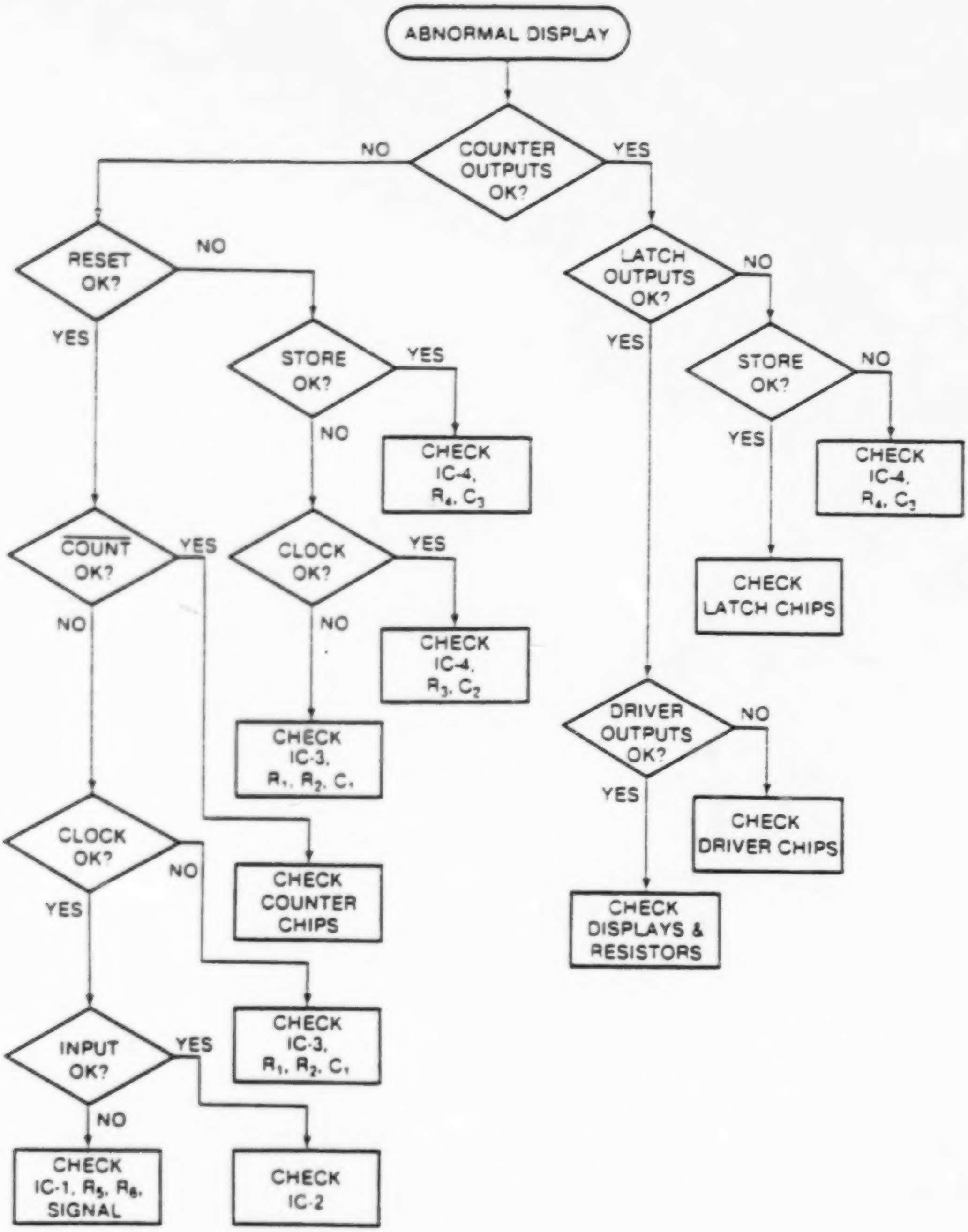
11-19 **MSI frequency counter.**


+5 V
IC-14
IC-15
IC-16
ALL 220Ω
IC-11
7447
IC-12
7447
IC-13
7447
LT
R_{B1}
R_{B0}
a b c d e f g
V_{CC}
D C B A
1K
IC-8
7475
IC-9
7475
IC-10
7475
4Q 3Q 2Q 1Q
EN 1-2
EN 3-4
4D 3D 2D 1D
IC-5
7490
IC-6
7490
IC-7
7490
B_{in}
A_{in}
$R_{0(1)}$ $R_{0(2)}$
R_1 500K
R_2 1K
C_1 5 µF
CLOCK
555
IC-3
STORE
RESET
R_3 1K
R_4 1K
C_2 0.1
C_3 0.1
74122
ONE SHOTS
Q_1
IC-4
CLOCK
INPUT
1/4 7400
COUNT
IC-1
Y_1
LM339
R_6 2K
SIGNAL
R_5 100K

11-21 Flowchart for troubleshooting the frequency counter of Fig. 11-19.



ABNORMAL DISPLAY
COUNTER OUTPUTS OK?
NO
YES
RESET OK?
NO
YES
LATCH OUTPUTS OK?
NO
YES
STORE OK?
YES
NO
CHECK IC-4, R_4, C_3
STORE OK?
NO
YES
CHECK IC-4, R_4, C_3
CHECK LATCH CHIPS
$\overline{\text{COUNT}}$ OK?
YES
NO
CLOCK OK?
YES
NO
CHECK IC-4, R_3, C_2
CHECK IC-3, R_1, R_2, C_1
DRIVER OUTPUTS OK?
NO
YES
CHECK DRIVER CHIPS
CHECK DISPLAYS & RESISTORS
CLOCK OK?
NO
YES
CHECK COUNTER CHIPS
CHECK IC-3, R_1, R_2, C_1
INPUT OK?
YES
NO
CHECK IC-1, R_5, R_6, SIGNAL
CHECK IC-2

COMPETENCY EXAMINATION RATING SHEET

Competency: Verify Proper Operation of a Frequency Counter.

Performance Objective: Demonstrate the ability to perform a minimum performance check of a frequency counter including troubleshooting adjustment of repair to departmental specifications, achieving 100% mastery on the performance exam.

STUDENT ______________________ Competency Mastered YES ____ NO ____

EXAMINER ______________________ Date of Rating ______________________

PERFORMANCE CRITERIA	STUDENT PERFORMANCE		
	Satisfactory	No. of Attempts	Completion Date
1. Demonstrated the ability to perform minimum performance check of the frequency counter.			
2. Demonstrated the ability to adjust or repair as necessary to achieve proper operation.			

Comments: